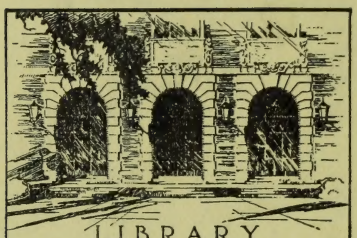


LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS
506
SOU
v. 8-9
cop. 3

NATURAL HISTORY AUG 31 1948 BIOLOGY

ACES LIBRARY

47.50

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. VIII.

(FOR 1884-5.)

ISSUED MAY, 1886.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.

1886.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Royal Society of South Australia.

Patron:
HER MAJESTY THE QUEEN.

Vice-Patron:
HIS EXCELLENCY SIR WILLIAM ROBINSON, K.C.M.G., C.B., &c.

OFFICERS.

[Elected October 6, 1885.]

President:
H. C. MAIS, Esq., M.I.C.E.

Vice-Presidents:
WALTER HOWCHIN, Esq., F.G.S. (Editor),
RICHARD L. MESTAYER, Esq., C.E.

Hon. Treasurer:
WALTER RUTT, Esq., C.E.

Hon. Secretary:
W. L. CLELAND, Esq., M.B.

Other Members of Council:

PROFESSOR RENNIE, D.Sc., F.C.S.
H. T. WHITTELL, Esq., M.D. (Representative Governor)
E. C. STIRLING, Esq., M.D.
J. W. BUSSELL, Esq.
D. B. ADAMSON, Esq.
W. E. COOKE, Esq., B.A.

Assistant Secretary:
MR A. MOLINEUX.

506
SOU
v. 8-9
cop. 3

ACES LIBRARY

CONTENTS.

PAGE.

J. J. East: On a Geological Section from the Head of St. Vincent Gulf Eastward across the Wakefield and Light River Basins (plate i.) .. 1

Ch. Winnecke: Plants collected in Central Australia 10

Samuel Dixon: Remarks on some Indigenous Shrubs of South Australia suitable for Cultivation as Fodder 14

W. A. Jones: Notes on Iridescent Clouds 28

Gavin Scoular: Past Climatic Changes, with special reference to the occurrence of a Glacial Epoch in Australia 36

Prof. R. Tate: Post-Miocene Climate in South Australia 49

E. Guest: Remarks on the Nomenclature of some South Australian Butterflies, with Observations 60

W. T. Bednall: Description of and Notes upon the Species of the Genera *Murex* and *Typhus*, known and recorded as existing on the Coast of South Australia.. 63

W. Ernest Cooke: A few Remarks about Weather Forecasting for South Australia 67

Prof. R. Tate: Additions to the Flora of Extra-Tropical South Australia, including Descriptions of Two New Species 71

Prof. H. Lamb: On the Persistency of Electric Currents in Masses of Iron.. 73

Prof. H. Lamb: The Cause of the Luminosity of Flame 74

F. S. Crawford: The Apricot Disease 77

Walter Howchin: On the Fossil Foraminifera from the Government Boring at Hergott, with General Remarks on the Section, and on other forms of Microzoa observed therein 79

Prof. Tate: Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a description of a New Species of Rhynchonella (plate vi.) 94

Prof. Tate: The Lamellibranchs of the Older Tertiary of Australia, Part I. (plates ii. to xii.) 96

MISCELLANEA.

The Dasyurus, a (?) Vegetarian—A. Molineux 159

Fungi Collected near Clarendon—J. G. O. Tepper .. .. .. ib.

Plants Collected near Stuart's Range in 1885—Chas. Winnecke .. 160

On the Occurrence of *Astrorhiza angulosa* as a Fossil in the Older Tertiary of Victoria—W. Howchin .. .. ib.

Bibliographical Notices: Australian Fossil Bryozoa 161

Notes on Some Mesozoic Plant Remains from South Australia 163

Abstract of Proceedings 164

By-Laws Relating to Sections in connection with the Society 169

Balance-sheet 170

Donations to the Library 171

List of Fellows, Members, &c. 177

APPENDIX.

Proceedings of Field Naturalists' Section 180

On a Geological Section from the Head of St. Vincent Gulf Eastward across the Wakefield and Light River Basins.

By J. J. East.

Plate I.

[Read November 4, 1884.]

INTRODUCTORY.

The sectional line here spoken of extends from Port Wakefield across the Wakefield Plains, and through the Adelaide chain of the Flinders Ranges to their eastern slopes overlooking the valley of the Murray River.

The form of the ground's surface naturally suggests its division into two portions, viz., a level or gently undulating plain reaching back from the waters of the gulf for 22 miles, when it gives place to a tract of hilly country. This hill region is formed by a succession of parallel ranges having a nearly meridional strike, and separated from each other by valley-plains often of considerable extent. The ranges as a rule appear about the same average height above the plains, but on a line from west to east they really, with the valleys between, form a series of terraces, each valley and range on the east having a greater absolute elevation than that on the west. The eastern range is the highest of all, the summits of several points being over 2,000 feet above the sea. It forms a wide-topped swell many miles long, and is known as the tableland. From the eastern slope of the tableland the surface of the country falls rapidly towards the Murray River, but no long creeks nor permanent waters exist in the 35 miles of scrub and plain which intervene between that channel and the hills.

In consequence of the terraced formation of the hill country the whole of the surface drainage is towards the gulf, the western ranges being drained by the River Wakefield, and the central and eastern ones by the Light and its tributary the Gilbert.

THE WAKEFIELD PLAINS.

In describing the series of beds or strata met with along the line of section it will be advantageous to begin with the western or "plains" portion.

On the edge of the gulf at Port Wakefield a deep borehole

sunk by the Government has revealed a great thickness of Tertiary beds resting directly on a primary rock composed of blue slate containing iron pyrites and bands of quartz. The Tertiary beds have been critically discussed by Professor Tate in Vol. IV. of the Society's Transactions, &c., and by him the series are divided into two portions, the upper beds being classed as "Recent Marine" and the lower beds "Pliocene Drift."

The Recent Marine does not extend far inland, and is succeeded on the surface by red loam, underlaid by red clay, which continues to Balaklava. Sinkings at this place pierce the loam and clay at about 80 feet, and then enter water-bearing strata of sand and gravel. The same occurs at Halbury on the Blyth railway line, and at several points in the scrub south of Balaklava. East of this township the red loam is found surmounted by a crust of travertine, and this in turn is covered by 20 to 30 feet of blown sand of a light-brown colour. It is this sand which by forming mounds gives the undulating character to the plains. A fine section of the sand, travertine, and loam is exposed by a railway cutting on the Blyth line just over the bridge crossing the Wakefield. These sandhills continue right back to the ranges, and where they adjoin the older rocks often develop flat beds of a fine-grained brownish-black ferruginous sandstone, which is extensively used for road metal. The manner of its occurrence is like that of travertine, and doubtless owes its origin to similar causes—aqueous solutions concentrated by evaporation.

Along the line of section no exploration has been made deeper than the gravel which underlies the red clay, but at several points southward the search for water has resulted in greater depths being reached. The Hundreds of Dalkey and Grace are by this means pretty well known, but in no instance have the wells reached the primary rocks. Among the sandhills west of Owen railway station wells which have been sunk over a tract of country six miles wide have passed through the gravel and entered blue clay at a general depth of a little over 100 feet from the surface. Twelve miles farther south in a well at Mallala—115 feet above sea level—the blue clay was met with at a depth of 80 feet. The water supply at this depth being insufficient and of poor quality, a borehole was continued from the bottom. The blue clay continued to a depth of 150 feet further, and then the drill entered a bed of quicksand and gravel, which afforded water with such pressure that it not only rose to the top of the bore, but flooded the well to a depth of 40 feet, at which point the water has found its level, or, what is more probable, the lateral soakage is equal to the supply from below. This well was sunk by the Milling Company for

engine purposes, and the water derived is eminently suitable for such uses, being clear and soft.

Where the plain slopes up to the foot of the hills the red clay or loam is found resting directly against the primary rock, and the river channels where they debouche on the plain show only a section of this upper bed or the overlying sand and travertine. Summarised, therefore, the strata of the plain consist in descending order of—

Blown sand	30 feet
Travertine	2 "
Loam and red clay	80 "
Sand and gravel, with brackish water .	2 "
Blue clay	150 "
	264 feet

Quicksand and gravel, with abundance of good water.

THE HILLS.

The rocks composing the hill country are divisible into three groups, each unconformable to the others. The newest formation is a gritty sandstone, often a ferruginous conglomerate or breccia. The coarser portions occupy the lowest levels, and from this the transition is a gradual approach to a lighter-coloured and finer-grained sandstone, which forms a cap to almost all the ranges. No fossils have been detected in it, and has been referred to various geological ages, from Miocene to the Desert Sandstone. Extensively distributed, it is also very thick. At Macaw Creek, south of Rhynie, it forms round-backed hills 200 feet high. In the valley of the Light, between Hamilton and Anlaby, it is also greatly developed. The most extensive and unbroken series of it is met with on the Alma range, where it forms a cap and flanking formation all the way from Stockport to Saddleworth. As might be inferred, the nature of this rock varies greatly, especially the upper portions. In some places, as near Undalya, it is a coarse soft sandstone; at Rhynie and west of Stockport it is quarried as a white freestone for building purposes. At Stockport itself and near Marrabel its ferruginous beds yield splendid tough road metal. On the Marrabel range it is compact, grey, hard, and barely distinguishable lithologically from the grey quartzite forming the core of the range.

The best exposure of this series is seen at Stockport, on the bank of the River Gilbert. There the western side of the channel is formed of very coarse conglomerate, consisting of quartz stones (some of them being as large as one's fist) cemented together by a ferruginous paste. The Gilbert has cut a channel through it, and passing westward it is seen at

length bounded by slates dipping eastward. Ascending these slates, the sandstone cap is found to get finer and finer grained until, as before stated, it becomes a freestone quarried for building purposes. Where not resting directly on primary rocks this sandstone rests on blue clay similar in appearance to that found under the red clay of the plains. Such is the case at Tothill's Creek, Butcher's Gap, Woolshed Flat, Salter's Springs, and Humphrey's Springs.

The frequent occurrence of similar patches of conglomerate in the beds of creeks which are still the main drains of the tract of country in which they are situated would at first sight appear to indicate that the sandstone just spoken of had its origin in running streams. The bedding of the sandstones, however, their dip and variation in texture, while indicative of formation by currents is not consistent with lacustrine or river depositions when considered in the light of their altitudes and distributions over extensive areas.

PRIMARY ROCKS.

The series of slates, quartzites, and crystalline limestones forming the main mass of the ranges have been tentatively classed under the somewhat ambiguous term of "pre-Silurian," which term, however, commends itself as being indicative of the extreme age to which these rocks undoubtedly belong. Along the line of section they are clearly divisible into two groups—an upper and lower—both upheaved and greatly faulted, and unconformable to each other.

Upper Group.—The upper group is much the thicker of the two, and consists of slates, soft aluminous rock, quartzites, flags, and sandstones. It is seen to best advantage in the Gilbert Valley along the line of section which passes through Riverton. In descending order the rocks here met with are

Greenish grey sandy slates and soft aluminous rock.
Pink and brown earthy slates.
Blue slates containing black iron pyrites.
Olive green slate.
Brown quartzite.
Olive green sandy slates.
White slatey sandstones, soft and sometimes earthy.
Blue flags.
Bluish grey sandstones graduating into micaceous flags.

All the above beds are seen in ascending order from about one mile west of Riverton to the foot of the Marrabel range, about four miles further east. The prevailing strike is N. 10 W. and dip eastward at a mean angle of 23 deg. from the horizon. Numerous quarries abound in the three lowest beds

which are worked locally, and furnish the building stone, flags, and road metal required in the neighbourhood.

Two miles south of the town the pyritiferous slates form a hard brown ferruginous shale, which constitutes a round-back swell of about half a mile in length. This change is probably due to the oxidation of the pyrites as they at times are found studding this rock like currants in a cake. The same rock is seen in the Light channel, about three miles below Hamley Bridge, and from it I have gathered pyrites which, while externally of a clear black colour, were of the original brass yellow towards the centre. At several other places the shale occurs on the alignment of the slate, among others at Dorrington's farm on the Marrabel range, where it is scarcely one hundred yards from the unaltered bed. Paddy's Knob (in the Northern Areas) on the Germein road near Wirrabara is another instance of this localisation of chemical changes.

The two upper beds of this group contain much soluble matter, and when treated with hydrochloric acid the pink variety loses one-third of its weight. Their soft, almost friable, nature and susceptibility to chemical action is the cause of their always weathering into rolling swells with sometimes deep watercourses at their bases. North-east of Tarlee the valley is deeply cut up from this cause.

About four miles east of Riverton a fault of upthrow occurs, which brings the lowest beds again to the surface. The beds appear to be somewhat thicker also, which, though doubtless is the case, is yet made more apparently so by the dip of inclination being lessened several degrees.

The Marrabel range presents its steepest face to the west, and has undergone denudation in a very irregular manner, due principally to the varying hardness of the Tertiary sandstone by which it is capped. The blue flags are seen at the fault which passes by Ettrick's ruined church. The olive green slates occur at the foot of the range ; the brown quartzite at intervals shows bare on its summit, and half-way down the other side is a quarry in the pyritiferous blue bed which has supplied the stone to build Marrabel. The next four miles is covered by the Tertiary sandstone, and the sequence of the rocks is ascertained by wells and exposures of rock at greatly denuded points north and south of the sectional line.

Another fault in this upper group of rocks is marked by the Julia range. From here to the table-land the strata are much disturbed and occasionally the angle of dip is very high and always easterly. The table-land range, however, dips westward, and must therefore form a synclinal trough under the upper portions of Julia and Pine Creeks. The eastern face of the table-land presents a steep and sometimes bluff face, over-

looking the Murray Plains, due to its having been faulted upward from that side. This last fault is a very long one, and runs in a general direction of N.N.W. and S.S.E. from Robertstown to Leake's Lookout, a distance of over 20 miles.

From Eudunda, which stands nearly on the line of fault, the surface of the country falls rapidly towards the Murray. A few swells, mostly of sandstone, appear, and in the railway cutting at Mount Mary the last of the Primary slates are seen. After this the fossiliferous beds of the Murray basin occupy the country further eastward.

Lower Group.—What I have termed the "lower group" of rocks forms the base of the western ranges, and consist of beds of slates, crystalline limestones, and quartzites. Nowhere, as far as my observations have extended, are they exposed in full succession except so far as the lower beds are concerned. The whole series is much faulted and disturbed, and the strike and dip very variable, but the latter is always at a high angle. As the results of numerous observations I have been led to accept the following as the sequence of the different beds in descending order :—

Grey talcose slate.
Grey quartzite.
Hard blue shale.
Crystalline thin bedded limestone with talc partings.
Siliceous thin bedded marbles.
Olive-green slate.
Brownish-white sandstone.
Green and grey sandy slates.
Thick bedded grey quartzite.
Yellowish clay slate.
Massive quartzite breccia.

Although, as previously stated, the strike of particular beds is never constant, the series as a whole has a general direction of N.N.W. and S.S.E. It forms the base of the Alma Range from Stockport to the River Wakefield, and of the Skilly ranges from the Wakefield to Clare. The road which runs west of the Clare hospital has a goodly proportion of marble in the metalling. The watercourses of the Skilly ranges have eroded channels through the softer slates and limestones, and in consequence the harder quartzites and sandstones remain standing in a series of narrow high parallel ridges which effectually shut out any direct traffic from Watervale or Leasingham to the plains on the westward.

Between the Skilly ranges and the main North Railway the ground is formed by rocks of the "upper group." The upheaval of the Skilly ranges from the westward has subjected

these beds to tremendous lateral compression, by which they were thrown into a series of folds, the culminating point being Mount Horrocks. In the immediate neighbourhood of Auburn the foliation is clearly displayed by the road cuttings. Four miles eastward the Pine Creek has worn its channel completely through the slates of the upper group down to the crystalline limestone of the "lower group." The exposure of limestone at this point was observed by Prof. Selwyn in 1859, when driving from Saddleworth to Auburn. A few yards to the westward is a dyke of dolerite, which is the only eruptive rock I have observed in this district, but I am informed that fragments have been found in the Skilly ranges, near Clare, by Professor Tate. Professor Selwyn records the occurrence of a granite dyke at the confluence of the Julia and River Light, about four miles south of the section. At Pine Creek this rock is quarried for road metal.

Between Riverton and Rhynie some of the weathered boulders of marble become deeply stained with iron oxide, and have a suggestive coralline appearance, and when an unweathered fragment is ground smooth the mass is seen to be composed of shot-like concretions cemented together. Specimens of this rock have been submitted to Prof. Tate and the Government Geologist, but were not recognised as organic formations. The same rock is traceable as far south as Stockport, beyond which the rocks disappear beneath Tertiary deposits; but at Templers, nine miles from Gawler, the debris from the well is talcose slate, similar to that found in other places occupying the highest position in the "lower group" series. The Alma plain is loam and drift resting on rocks of the "upper group," and is bounded on the west by the low Dalkey Range. At Stockyard Creek the wells show talcose slate as at Dry Creek, west of Tarlee. The dip is easterly, and passing west to the Wilderness Creek, near Owen, there is an exposure of the limestones, also dipping east. Seven miles north of this, where the Wakefield River forces its way through a gap on to the Wakefield Plains, the sequence of the rocks is again observable in the natural section there formed. This Dalkey Range, though much lower in altitude, is the counterpart of the Alma Range on the east—a base of Primary rocks capped with Tertiary sandstone. The beds of the "upper series" resting between those two ranges show much false bedding, and along the Hermitage Creek—under the flank of the thick quartzites—are distinctly inverted.

Stockyard Creek is the most southern point of the "lower group" in Dalkey. The rocks of the upper group seem to flank it on the east and south, while Tertiary deposits bound the western side. The channel of the Light from Hamley Bridge

to Redbanks show only a section of greatly faulted beds belonging to the "upper group."

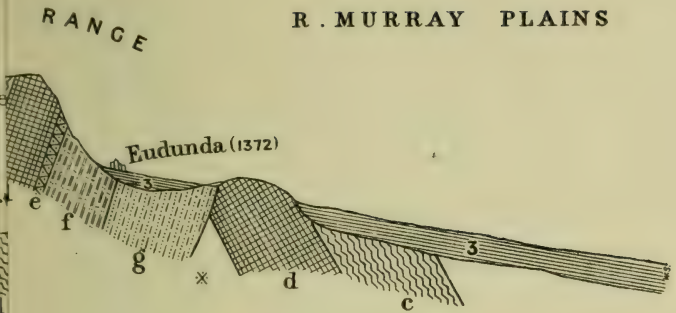
SUMMARY.

To summarise the observations made on the two Primary groups, the whole district may be considered as formed of slates and sandstones (upper group), broken up on its western edge by upheaved limestones, slates, and quartzites. The varying dip and strike, great metamorphism and faultings, together with the presence of intrusive rock, characterising the "lower group," suggest that an immense period elapsed between the depositions of the "upper" and "lower" series. The lower group had been faulted and upheaved before the upper beds were deposited, and in the subsequent convulsions of nature the force which upheaved and faulted the whole country still further faulted the underlying limestone group.

The occurrence of the Tertiary sandstone capping the old Primary rocks is suggestive of its being a shallow water formation, and as a slow upheaval went on the products of denudation would necessarily gravitate into the lowest hollows —precisely as we now find them—and finally form the conglomerate beds so common in the different valleys. The eroding action of the watercourses have cut their channels through them where conditions were favourable, leaving the conglomerate beds in patches on the flanks or slopes of hills overlooking the valley. Where, then, a conglomerate patch exists above a watercourse, it bears silent testimony to the eroding influence of the stream below. Further than this, it testifies how very long a period has really elapsed since the dawn of what we still call "recent" geological time.

In the absence of palæontological evidence all identification of rocks based solely on their lithological features is open to a greater or less amount of doubt, but a faithfully recorded sequence of conformable strata in any one locality becomes a clue deserving consideration when examining neighbouring districts the topographical features of which suggest a relation thereto.

It has been shown that the upheaval of the western side of the Wakefield basin has had the effect of folding and faulting the beds of the upper group, producing the swells which by denudation of the softer portions now form the numerous parallel ranges extending northward. In the troughs of synclinal folds, or along the line of faults, the numerous creeks have worn deep channels, and owing to this circumstance, *i.e.*, the water following an indicated or ready-formed system of drainage, there are very few gorges or natural sections throughout the whole district.



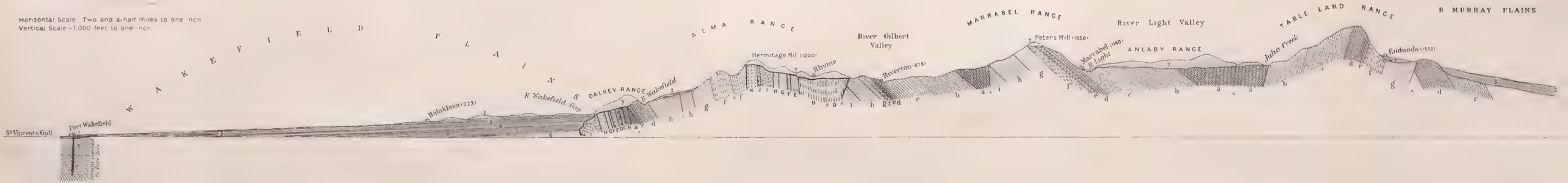
* ote height above sea level

Stratigraphical Sketch

ACROSS THE BASINS OF THE

WAKEFIELD AND LIGHT RIVERS.

Horizontal Scale Two and a-half miles to one inch
Vertical Scale – 1,000 feet to one inch



TERTIARY GROUP.

1 Recent Marine
2 Blown sand
3 Drift, loam and clays
4 Sand and gravel
5 Tough hard blue clay
6 Quicksand and gravel
7 Upland Miocene (sandstone and conglomerate)

PRIMARIES—UPPER GROUP.

a Greenish grey sandy slates and soft aluminous rock
b Pink and brown earthy slates
c Blue slates containing black iron pyrites
d Olive green slate
e Brown quartzite
f Olive green sandy slates
g White slaty sandstones, soft and sometimes earthy
h Blue flags
i Bluish-grey sandstones graduating into micaceous flags

PRIMARIES—LOWER GROUP.

A Grey talcose slate
B Grey quartzite
C Hard blue shale
D Crystalline thin bedded limestone with talc partings
E Siliceous thin bedded marbles
F Olive-green slate
G Brownish-white sandstone
H Green and grey sandy slates
I Thick bedded grey quartzite
J Yellowish clay slate
K Massive quartzite breccia

Faults denoted thus x
Attached figures denote height above sea level

SURVEYOR GENERALS OFFICE ADELAIDE Fraser & Crawford Photolithographer

What lies beneath the quartzites of the lower group is not visible in this district, but in the northern areas, at Tarcowie Springs, in the Appila Creek, a similar series of beds—which for the reasons just given I assume are identical with the Wakefield group—rest directly on mica schists, and both are pierced by a large dyke of porphyritic greenstone. The whole of the Pekina Range, extending as far north as Oladdie Station, seems identical in structure to the Wakefield basin—two unconformable series of beds, the one principally argillaceous, the other chiefly calcareous and siliceous. Between the Pekina and Wakefield beds lies the basin of the Broughton River, in which, according to Selwyn, the whole country is composed of one single series of rocks in anticlinal and synclinal undulations extending from Bundaleer to the foot of Mount Bryan. This series I have traced into direct connection with what I have termed the "upper group" in the foregoing pages, and despite the absence of fossil evidence the inference is a very strong one that the Pekina and Wakefield "lower group" rocks are identical. We have thus an axis of upheaval extending from the latitude of Port Augusta to the shores of St. Vincent Gulf quite distinct from that of the Hummocks and Mount Remarkable systems, and nearly on the central meridian line of the Flinders Range, when considered as a whole.

South of Kapunda the Adelaide chain has been so metamorphosed that lithological aspects on a large scale cannot be grouped in such a manner that the rocks shall of themselves bear the impress of identity, but the numerous references given by Selwyn indicate that the sequence of each conformable series will yet suffice to connect them with the two groups of the Wakefield basin.

EXPLANATION OF PLATE I.

The sectional line runs from Port Wakefield slightly north of east to the Murray Flats beyond Eudunda. From the Dalkey Range to the Hermitage Hill, the beds vary much in strike and dip and one bed is distinctly inverted. One mile east of Rhynie the faulted beds dip north-westerly, and the line of strike is only 25° from that of the section. The table-lands range is crossed at about 15° less than a right angle. All the other portions of the section are in the direction of the true dip or at right angles to the line of strike.—J. J. E.

Plants Collected in Central Australia,

Between lat. 22° 30′ and 28° S., and long. 136° 30′ and 139° 30′ E., by Ch. Winnecke, Esq., during his expedition in 1883; examined by Baron Ferd. von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

[*The following list was published in Mr. Winnecke's official report, but has received corrections from the author, and was ordered to be printed in the Transactions, by the Council of the Royal Society, December* 14, 1884:—]

Lepidium papillosum, *F. v. M.*
Erysimum Blennodia, *F. v. M.*
Capparis Mitchelli, *Lindley.*
Capparis lasiantha, *R. Brown.*
Drosera Indica, *Linné.*
Owenia acidula, *F. v. M.*
Bergia perennis, *F. v. M.*
Tribulus hystrix, *R. Brown.*
Zygophyllum Howittii, *F. v. M.* Petals about one-eighth inch long; filaments without appendages; anthers, when fully opened, almost roundish; radicle often three times as long as the cotyledons.
Erodium cygnorum, *Nees.*
Gossypium Australe, *F. v. M.*
Lavatera plebeja, *Sims.*
Abutilon leucopetalum, *F. v. M.* A variety with yellow petals of nearly two inches in length; some of the stamens fully as long; upper part of the styles exserted; fruit not seen. This plant offers an approach to A. exonemum, *Mons. Thozet*, sent from Muellersville, specimens with flowers fully three inches long.
Melhania incana, *Heyne.*
Seringea integrifolia, *F. v. M.*
Triumfetta Winneckeana, *F. v. M.* Leaves roundish or verging into an oval form, denticulated and somewhat crisp at the margin, velvety on both sides; sepals narrow, dorsally terminated by a minute conical appendage, petals downy towards the base; stamens numerous; ovary three-celled; fruit large, on slender stalklet, almost globular, indehiscent, thinly tomentose, copiously beset with long spreading bristle-like, nearly glabrous at the summit, hooked prickles. The nearest affinity of this plant is with T. leptacantha, but the fruits are much larger, and not glabrous; indeed,

they are in size similar to those of T. procumbens, but provided with longer and much more slender prickles. Leaves and flowers have been described from mere remnants adhering to the fruit.

Frankenia laevis, *Linné.*

Claytonia Balonnensis, *F. v. M.*

Atriplex leptocarpum, *F. v. M.*

Atriplex Muelleri, *Bentham*, var. lobaticarpa; dwarf, procumbent or ascendent, leaves small; fruit-bearing calyces minute, to the middle bivalved, digitate or flabellate, rhomboid, anteriorly cleft into five deltoid-semilameolar lobules, the lateral of which divergent or recurved, but often abbreviated, the lower portion of the fruit-calyx thickened towards the middle, but not appendiculated. This may possibly require specific separation, but the degree of variability of the group of saltbushes to which this plant belongs needs yet further to be studied in the field or from augmented museum material. The plant here under consideration reminds us also of A. fissivalve, from which it differs in less succulency, smaller leaves, less transparent, and less deeply valvate fruit-calyces, with shorter lobules without dorsal appendages.

Kochia triptera, *Bentham.*

Salsola kali, *Linné.* A variety of flowers and fruits crowded headlike on abbreviated branches; appendages of calyx minute

Ptilotus latifolius, *R. Brown.*

Ptilotus alopecuroideus, *F. v. M.*

Ptilotus obovatus, *F. v. M.*

Polygonum plebejum, *R. Brown.*

Rumex crystallinus, *Lange.* Some of the plants only one inch high, though fully in fruit.

Macgregoria racemigera, *F. v. M.*

Isotropis Winneckei, *F. v. M.*, in Melb. Chemistry, Febr., 1884. An entirely new plant.

Crotalaria dissitiflora, *Bentham.*

Psoralea patens, *Lindley.*

Indigofera viscosa, *Lamarck.*

Swainsona laxa, *R. Brown.* A variety with somewhat larger flowers; lobes of the calyx considerably shorter than the tube, the two upper rather blunt; lateral petals dark violet-coloured towards the summit; stipe of pod slightly longer than the calyx.

Glycine sericea, *Bentham.* Reminds of Galactia tenuiflora.

Petalostylis labicheoides, *R. Brown.*

Bauhinia Leichardtii, *F. v M.*, var. cinerascens. In this singular variety the rust-coloured silky vestiture of the

calyces and petals is replaced by a thin dull-greyish tomentum. The same form has been obtained on Julia Creek, a tributary of the Flinders River, by Mr. Armit; there particularly the petals become glabrescent. The leaflets are narrower than usual. Fruit for further comparison is not available. The far extratropic Bauhinia of Cooper's Creek is B. Carronii.

Neptunia gracilis, *Bentham.*

Acacia dictyophleba, *F. v. M.* Young pod broad linear, viscid, straight, flat, not hairy, somewhat thickened at the margin; stipe short.

Calycothrix longiflora, *F. v. M.* This has recently been also collected within the limits of New South Wales, near the Warrego, by Mr. Betche.

Melaleuca glomerata, *F. v. M.* Flowers small; tube of calyx thin-velvety, lobes short and blunt; petals tender-membranous, almost colourless, ciliolated, otherwise glabrous; stamens, when dry, pale yellowish, five to seven in each bundle; the connate portion about as long as the petals, but much shorter than the free portions of the filaments.

Eucalyptus gamophylla, *F. v. M.* On the specimens now collected the upper leaves become narrow lanceolar, continuing opposite or getting scattered.

Eucalyptus microtheca, *F. v. M.*

Lythrum hyssopifolium, *Linné.*

Ammannia multiflora, *Roxburgh.*

Haloragis Gossei, *F. v. M.*

Didiscus glaucifolius, *F. v. M.*

Pimelea simplex, *F. v. M.*

Loranthus Quandang, *Lindley.*

Melothria Maderaspatana, *Cogniaux.*

Pomax umbellata, *Solander.*

Oldenlandia tillæacea, *F. v. M.*

Dentella repens, *Forster.*

Calotis cymbacantha, *F. v. M.*

Calotis lappulacea, *Bentham.*

Vittadinia Australis, *Richard.* Fruit specimens only two inches high.

Pterigeron adscendens, *Bentham.* A dwarf form, with larger ligules of the ray-florets.

Epaltes Australis, *Lessing.*

Myriocephalus Rudallii, *F. v. M.*

Myriocephalus Stuartii, *Bentham.*

Helipterum floribundum, *Candolle.*

Gnaphalium luteo-album, *Linné.*

Senecio Gregorii, *F. v. M.*

Wahlenbergia gracilis, *A. de Candolle.*

Isotoma petræa, *F. v. M.*
Brunonia Australis, *Smith.*
Erythræa Australis, *R. Brown.*
Duboisia Hopwoodii, *F. v. M.*
Solanum oligacanthum, *F. v. M.*
Nicotiana suaveolens, *Lehmann.* The flowers in some of the specimens less than an inch long.
Stemodia Morgania, *F. v. M.*
Justicia procumbens, *Linné.*
Ipomœa Muelleri, *Bentham.*
Cynanchum floribundum, *R. Brown.*
Pollichia Zeilanica, *F. v. M.*
Halgania cyanea, *Lindley.*
Heliotropium filaginoides, *Bentham.*
Teucrium racemosum, *R. Brown.*
Clerodendrum floribundum, *R. Brown.*
Newcastlia spodiotricha, *F. v. M.* Found also by Mr. Kayser at Eyre's Creek; by Mr. Giles, near the Alfred and Mary Range; and lately near Mount Everard. Corolla deep blue.
Dicrastylis Dorani, *F. v. M.*, var. eriantha; leaves narrower, conspicuously tomentose; glomerules of flowers two or more superposed along the stalks; calyces involved in a dense woolly vestiture; corolla as in the normal form, almost bell-shaped, its tube short and turgid, the lobes obtuse. The Rev. H. Kemp sent a small-leaved variety from the Finke River.
Dicrastylis Lewellini, *F. v. M.* Tube of the corolla cylindrical, longer than the rather acute lobes; the fifth stamen between the two smaller corolla-lobes often altogether wanting, but sometimes developed and quite perfect. This and other rare plants brought by Mr. Winnecke extend probably along sandy tracts of country into Queensland territory.
Eremophila Macdonnellii, *F. v. M.*
Eremophila Willsii, *F. v. M.* A variety with branches and leaves glabrous.
Eragrostis speciosa, *Steudel.* Fully in flower at less than six inches in height.
Aristida stipoides, *R. Brown.*

Remarks on some Indigenous Shrubs of South Australia suitable for Cultivation as Fodder.

By Samuel Dixon.

[Read February 5, 1885.]

In considering some of the fodder plants of South Australia, instead of drawing your attention to the herbs and grasses, which are popularly looked upon as comprising our only stock foods, I am desirous of making some practical remarks upon a number of plants, usually shrubs or small trees, which constitute a most important part of the food of sheep and cattle, especially in the drier and more arid portions of this colony, some of which are to be found widely spread through northern districts, and extending to our eastern and western boundaries. The subject cannot be exhausted in one evening, but I feel that in view of its great importance to the well-being of the colony I may by bringing it under the notice of the Royal Society of South Australia assist in spreading a knowledge of the advantages of preserving, cultivating, and increasing the growth of a class of stock food which suffers but slightly from droughts, and which by its abundance adds greatly to the numbers of stock depasturing in certain areas, and by providing a constant supply of wholesome food promotes the growth and quality of that wool which is our chief export; and finally, adds so much flavour and sweetness to our mutton. It seems very desirable that many of these plants should be extensively cultivated, as their foliage becomes available when the grass is either gone or has lost all its nutritious qualities. In the large estates used solely as sheep-walks, lying mostly to the north of Adelaide, if belts of these native shrubs were laid out and the sheep only admitted during the months of April, May, June, and July, I am convinced the condition of the sheep would be better maintained, and consequently the growth of wool sounder and more abundant; the percentage of lambs would be higher, and in the long run more stock would be carried on the same area.

The study of shrubs edible for stock is one of the very greatest practical importance not only to the sheep farmer, but to all dependent on him in business; the presence or absence of certain of them renders the occupation of large tracts of country profitable or the reverse, and an adequate knowledge of them is of the first importance. At present very few of

those whose interests are bound up with stock can either name correctly or accurately describe the plants on which they indirectly subsist, although everywhere in Australia amongst practical men certain prevalent forms of vegetation give a name to well-understood sorts of country; for besides the general distinction of grass country or saltbush country we have in each of the colonies familiar expressions roughly denoting the healthiness or otherwise of certain areas, such as the "jam" country of West Australia, named from an acacia whose wood is scented like raspberry jam; or again, in New South Wales, another acacia, the "myall," with violet-scented wood, is a certain sign of the healthiness of certain districts; or in our own colony, "mulga" country defines certain peculiarities of soil and climate.

Very heavy losses have arisen from sheep farmers being misled as to the food qualities of the scrubby vegetation. For instance, many of the scrubby plants of the Murray Scrub are excellent fodder; others, characteristic of the South-East and Kangaroo Island, are so deficient in nutriment that sheep can barely exist, as they are mainly Hakeas, Grevilleas, Melaleucas, Banksias, &c., whereas the shrubs to which your attention is to be directed greatly assist in producing that excess of stearine in tallow which is the main cause of stock retaining their fat during long journeys, and this excess of stearine is conspicuous in cattle fattened amidst the saltbush and mulga of the North. But, on the contrary, the deficiency of stearine in stock fattened in the South-East is the reason why they "waste," or in other words, lose condition so much before reaching the Adelaide market.

It is the more desirable to consider this subject, because I fear that in some localities many of the most valuable of our shrubs are doomed to extinction from the fondness of stock for them and from that system of overstocking which too commonly prevails, and because in some localities—as, for instance, from the east bank of the Murray River to the Victoria border—the rabbits are barking and completely destroying all those shrubs which gave that region its chief value as a grazing country; and as the seasons when sufficient rains fall to give a good growth of grass are very irregular and uncertain, a vast area is likely to become more or less a real desert.

It is also noteworthy that stock do NOT in different localities invariably eat the same plants; of this, the Native or Cypress Pine (*Callitris verrucosa*) is a striking instance. On the Murray and in the North it is greedily eaten wherever stock can reach it, but on the western slopes of the dividing range in New South Wales and to the south-east of Cobar, the same tree becomes a real pest to stockholders, for, seeding very abundantly,

a dense growth of young pines prevents grass from growing; and there is not grass enough to carry fires through the country, as was the case before the country was stocked, and the result is that land there is now much less profitable to occupy.

The leading characteristics of our vegetation are peculiarly adapted to the arid zone it occupies, and which for fodder plants capable of withstanding protracted droughts is, I suppose, the richest in the world. Compared with South Africa, I can personally testify to its great superiority; and in the corresponding zone in North America the census of fodder plants is also much smaller, while in South America the cactus family (few of which are edible) too largely prevails.

To conclude these preliminary remarks, permit me to acknowledge very gratefully the kind assistance of Prof. Tate in lending specimens and in furnishing me with the scientific names necessary to identify plants, many of which, so far, have no common name, but where one exists I gladly use it; and finally, my only title to address members of this Society arises from a close practical observation continued for many years over large areas of this and the adjoining colonies.

I propose to mention first those plants which are common around Adelaide and in our moister climates, and afterwards to describe those belonging to more arid regions, but which are well worthy of cultivation wherever they will grow.

Bursaria spinosa.—A very common bush, named from the supposed likeness of its heart-shaped seed vessels to the pods of Shepherds' Purse, and from a few thorny spines much better deserves its second name. The flowers are small and white, in large pinnacles, and most abundant during summer. In the South-East it grows to be a small tree with larger leaves (and without spines) than is ever found this side of the Murray. Sheep eat it as soon as the grasses dry up, and where abundant makes a good "stand-by," and is of great value in late seasons. Its spines prevent its being eaten out like the last described. It stands pruning well, and would be serviceable as an ornamental hedge to cottage gardens.

Pomaderris racemosa.—This is another common bush in the moister districts, and seldom exceeds two feet in height, with an abundant foliage of smallish roundish leaves. The flowers are inconspicuous in small clusters, and the leaves when chewed or soaked are found to be slightly mucilaginous; this explains the fondness sheep have for this plant. It always seems fresh and green, and stands stocking well.

Pittosporum phyllæroides.—A small tree, with whitish bark, and drooping foliage of narrow leaves; flowers small and

scented; seed vessel before opening is oval, and of a bright orange colour, highly resinous, and its flavour is most disagreeable; but sheep are exceedingly partial to its foliage, and when one succeeds in pulling down a branch the rest make a rush to partake of such a dainty, and owing to this the tree itself is like to be exterminated, although originally very common in the limestones of Port Lincoln and the Murray. Were this cultivated, and sheep only admitted occasionally to the enclosures, it would never reach a troublesome height. Like most of its family, it is easily raised from seed.

Casuarina quadrivalvis.—The Sheaoak so common around Adelaide. All stock devour this tree, and in Port Lincoln the fallen catkins (male infloresence) form the chief sustenance in winter on much of the overstocked country. In many parts the ground, if fenced off, is quickly covered with the young trees, and if after the third year the sheep were admitted only during the winter they would be prevented from growing too high. It is too sour to be very useful to ewes rearing lambs, but if sheep only had enough of it, the "brake," or tenderness of fibre, would often be prevented in our finer wool districts, and much money saved by the increased value a sound staple always commands.

Acacias.—The Wattles of various sorts are common almost everywhere. The common or Golden Wattle, *A. pycnantha*, is now being extensively cultivated for its bark; for grazing, however, its value is not so well recognised, but I am of opinion that in winter its value as an astringent is very great, as sheep often suffer from a diahorrea caused by eating frozen grass, and if access be provided to any of the varieties of Wattle this is prevented, and the improved clip will repay the woolgrower the extra trouble of cultivating this ornamental and beautiful tree.

Acacia melanoxylon. — The Blackwood, which is confined with us to the South-East and our cooler southern valleys, is of more use for its timber (which is one of the handsomest furniture woods in Australia), than for its foliage, which, although eaten by cattle and sheep, is not of the greatest value; but the contrary is the case with the mulga, *Acacia aneura*, a shrubby tree of the very greatest importance in Central Australia, where it covers large areas, sub-varieties of which there are many, being somewhat difficult to define, varying a little according to the locality. The stony ranges, the rich red loamy plain, and the sandhill country have each a mulga differing mostly in the size of the leaves and position of the branches, and recognised by the aborigines under distinctive names, the typical mulga having numerous branches at nearly right

angles to the main stem. The narrow leaves are comparatively veinless—hence its specific name—and the flowers growing singly are of oblong shape, instead of spherical, like *A. pycnantha*. Its most remarkable characteristic, however, is the mucilaginous quality of its foliage, a leaf, when chewed, yielding a distinct flavour of gum, and without that astringent taste so common in Acacias grown in the moister regions. The presence of mulga in sufficient quantities is of the first importance in runs situated in the more arid portions of Australia as being not only the best stand-by, but as furnishing posts for fencing, the timber being very close-grained, hard, and lasting. As to how long the timber (generally of small size) will remain in the ground without decaying it is very difficult even to guess at, for it frequently happens that old forests of it are found standing evidently killed by fire, amidst a growth of young trees, which must have taken many years to grow to their present size, for the mulga is a very slow grower, but if cultivated in a moister climate I think would grow more rapidly, and yield a less scanty foliage. Amongst stockmen it has an evil reputation, as wounds caused by riding through scrubs of it often fester, and are difficult to heal. The most southern limit of it that I am aware of is at Anabama, some 90 miles from the Burra, on what is well known as the Pegline, the surveyed road to the Darling. It has been used extensively for smelting at Cobar, and exists around Silverton, and no doubt its close-grained charcoal will be very useful in reducing the silver ores there.

With the view of getting precise and reliable information as to the properties of the scrub in question, a sample of it was forwarded to Mr. William Johnson, the analytical chemist for the Victorian Government, who further submitted it to Baron von Mueller, the Victorian Government botanist, and it affords me considerable satisfaction to give you an extract from the report of Mr. Johnson as to the value of mulga: — "Examined chemically, it has been found to contain a large quantity of starch and gum, together with albuminous bodies and other constituents common to all vegetables. It is destitute of any poisonous properties, and, viewed as an article of food, must be very nutritious to all animals eating it. The mineral constituents amount to two per cent., and consist of carbonates of lime and potash, together with sulphates and chlorides, all very useful in the animal economy." Baron von Mueller's report is purely confirmatory of the above, and need not be repeated.

Acacia salicina—The Broughton Willow, as it is called in the North, being found mainly on the River Broughton and its tributaries. A very handsome little tree with drooping

branches; a good deal eaten by sheep and cattle. It resembles some of the drooping myalls of New South Wales; its seed-pods long and narrow, each seed being surrounded by a velvet-like thread or aril of a deep red orange colour; like most of the family, its seeds germinate more surely and quickly by being soaked in boiling hot water. The procession caterpillar destroys many trees by eating off the foliage, and the singular silk bag filled with the exuviæ of this destructive insect are to be found hanging in large numbers on the trees. *A. Oswaldi*, found on the Murray, is much less handsome, but is also eaten by stock.

Cassia eremophila.—A pretty little shrub with three small leaflets on each side the leafstalk, flowering abundantly in the Spring; the flowers bright yellow, scented, and nearly half an inch across; easily propagated, and both pods and leaves eaten by sheep; is widely spread in dry regions.

Cassia phyllodinea.—This species is named from its leaves being merely flattened phyllodes, and these are bifid at the extremity. This is inedible, excepting the pods when green, and is a nuisance in spreading over the warm loamy soil of the Lower Darling and similar country here; but, unlike the foregoing, grass will not grow beneath it, and is mentioned to prevent its being grown in error.

Cassia artemisioides.—This is one of the handsomest of the tribe, and is worthy of being cultivated for its very showy yellow blossoms.

Templetonia retusa.—Another showy leguminous plant, which is not uncommon on limestone soils near the sea, but grows very freely on deep, rich, red soils. Its large red pea flowers are abundantly produced, and sheep devour the green pods and the leaves also; it is easily raised from seed, and not growing too high, and the branches being close and the foliage abundant, would be useful also as a "breakwind" on exposed plains. A very handsome dark-flowered variety is common on the Flinders Range. The specimen came from the Port Germein Pass.

Myoporum platycarpum.—The so-called Sandalwood of the Murray, and is common in dry limestone soil throughout the less humid parts of the colony. Its leaves seem to be eagerly eaten by sheep when they can reach them; but the tree generally grows from 20 to 30 feet high, and is often felled for sheep when long droughts prevail. If the branches are lopped off the tree soon starts a fresh growth, and by the time another drought comes has often a sufficient growth to again bear lopping. It is often wantonly destroyed, and should be protected by regulation. It is a very elegant tree, having quan-

tities of small white blossoms in January or February, and is well worth growing as a "stand-by." Had the City Gardener planted this tree in the North Adelaide Park Lands, on the limestone soil, the result would have proved much better than planting red gum, elms, &c., which can only have a miserable existence before they finally die off. The timber has a pleasant scent when burned, but if used as posts, is liable to be eaten and destroyed by beetles.

Santalum acuminatum.—The Quondong, or Native Peach, belongs to the real Sandalwoods, and is one of those shrubs which soon disappears with heavy stocking. Cattle breaking it down, and sheep eating off the shoots soon kill the trees, and young ones are very few and far between ; in fact, from my observation, I believe that to be swallowed by the emu is almost necessary for the germination of its well-known seed. I can hardly recommend it for general purposes as a fodder plant to be cultivated, for, although its foliage is very nutritious, the plant seems too tender except in rich moist nooks. Its very light green leaves have a yellowish tint, which in shrubberies would form a good contrast, and when covered with fruit of the brilliant shiny crimson so well known to bushmen is a very striking object in the dull green usually around.

Eremophila longifolia.—The Dogwood of bushmen, and named by them from the offensive smell which the leaves have when crushed. The tree itself is not uncommon, and may be known by its woody seed vessel, covered by a black shiny skin; by its dull red blossoms, nearly two inches long; and drooping leaves three to four feet long. It likes deep rich soil. Sheep are exceedingly fond of its foliage, and they are apt to eat even the twigs, so that when grown it is necessary sheep should only have occasional access to it. It is one of the first to be barked by rabbits. Another species, *E. Brownii*, has a bright scarlet-coloured flower, but the foliage is too scanty to render the plant worth attention. It was common on the hard limestones of Port Lincoln, but is now much scarcer there.

Geijera parvifolia.—The Sheep Bush. Sheep only are particularly fond of this bush, which grows on hard limestone soils, and seems quite unaffected by droughts. It seldom grows more than ten feet high, and has a number of small stems from the crown of the roots. You will always find every leaf eaten off within reach of sheep, who eat it at all seasons. The seed vessel always contains two small shiny black seeds, ripening at the end of summer. The dense growth of this shrub gives a good deal of shelter, and in its native state affords the kangaroo shelter from the sun. I should like to see this shrub established on all sheep farms. The specimen came from Telowie. It ought never to be destroyed wantonly.

Nephelium oleæfolium (v. Mueller).—*Heterodendron oleæfolium* (p. 124, "Native Plants of Victoria").—This small tree is also common, and the bitter taste of its dull grey leaves resembles quinine. Both sheep and cattle feed very greedily on this little tree, but as soon as stock are removed from the paddocks it is one of the first to recover, throwing out fresh leaves, and like the last described is of very great value in dry seasons. I have seen it as far south as the Government Farm, Roseworthy, but in the Bourke district of New South Wales are the largest specimens I have seen, the rich, warm, loamy soil seeming to suit it exceptionally well; the increased size and dense foliage giving a welcome shelter from the sun. Judging, too, from the bitter flavour it is likely to be of use in medicine, and I hope some of your learned members of the medical profession may be induced to experiment with it. It cannot be too frequently grown.

Leptomeria aphylla.—This stiff, awkward-looking shrub is well described as *aphylla*, only the very youngest shoots showing traces of anything like leaves; in fact, the shrub resembles a parcel of green sticks and small stiff twigs. It is by no means ornamental, and its small red fruits, with a little green knob at the end, are too inconspicuous to attract attention. Sheep, however, find it pleasant to browse on, and in doing so often fill the wool on the top of the neck with its small twigs. I can hardly recommend the cultivation of this queer-looking shrub, but it should never be destroyed where it grows naturally.

Exocarpos cupressiformis. (The Native Cherry).—This very handsome tree is a favourite food with sheep and cattle, and a young tree is consequently somewhat uncommon. If it can be readily grown, however, there is no doubt of its desirability, but as it likes rich soil and a cool climate, I do not expect it will be used as a fodder-plant generally.

Gossypium Sturtii.—This very showy summer-flowering shrub, named after the gallant explorer, Colonel Sturt, is a native of the glens of the mountain ranges of the interior. It grows very freely in gardens around Adelaide, is very easily propagated, and affords stock a good summer feed; and is as handsome in pleasure grounds as it is useful as a sheep and cattle food. It is a suitable plant for gardeners to cultivate, and likes a fairly rich soil, and when cut down (if not too close to the ground) sends out plenty of young shoots. Its absence from the city Park Lands is a good specimen of their general mismanagement, and how little native shrubs are appreciated.

Sida petrophila.—This showy little plant is well named *petrophila*, or rock-loving, being most common on the top of all northern ranges in the saltbush country. The disc-like yellow

blossoms and downy grey-green leaves render it very conspicuous, although it does not much exceed three feet high, and, like other plants affecting the same situations, flowering after copious rains. There should be no difficulty in growing it commonly, but it does not like too moist a situation. It seems to be as much liked by sheep as by marsupials, and I have seen large tracts quite cleared by their united efforts.

Dodonæa viscosa.—The native Hop Bush, and one of the largest of the Dodoneas growing here. Its chief use as a fodder plant is in the "hops," as bushmen call the four, round, winged seed vessel, each section of which contains a little black seed. It produces large quantities of seeds, and during November and December, until its coppery-red seed vessels get too dry, sheep and cattle eat them eagerly. The foliage is resinous, and to see the bush eaten down is a sure sign of "hard times" with the sheep. It is sometimes twelve feet high or more, and likes warm, red, sandy ground. In the old times when shepherds were kept to look after sheep, the hutkeepers used the "hops" as a substitute for the real hop in making sugar-beer and to make yeast for bread. It is very suitable for cultivation in shrubberies.

Lycium australe.—This is a very useful fodder plant indeed. It grows up to four feet in height, and is thickly covered with short oblong juicy leaves. Drought never seems to affect it, and having many spiny points, sheep can never quite eat it out. It is also one of the very few shrubs in saltbush country which throw out abundant suckers. The flower is small, lilac-white, and salvia-shaped; the fruit is also small, bright red, and of a sweetish tomato flavour. The shrub is abundant nearly everywhere, and is often recklessly destroyed by farmers in their attempts to grow wheat in unsuitable places. I believe it to be very fattening, and likes saline soils.

Zygophyllum fruticulosum.—This small shrub is very common in calcareous soils and sandhills. It has small juicy linear leaflets in pairs. The seed vessels resemble in shape and size the *Dodonæa* above described. It has an abundance of single yellow flowers, and on Yorke's Peninsula, around Wallaroo, it grows very plentifully on long fallowed ground. It is also common among the mallee scrubs, and sheep, feeding where it is common, care less for water, finding abundance of moisture in its singular leaves. From a letter of Baron Sir F. v. Mueller to Prof. R. Tate it appears that the *Zygophyllum* family is poisonous in South Africa, and certainly I have had reason to suspect *Z. glaucesens* of killing sheep, but have never had the opportunity of testing it. I am, however, very confident that *Z. fruticulosum* is not injurious, for although not universally and at all

seasons eaten by sheep, it is quite eaten out in the Murray River scrubs, and I never knew any ill-effects produced by it. The other *Zygophyllums* are seldom or never eaten by sheep.

Goodia medicaginea.—This handsome shrub will grow to four or five feet high, or even higher, and retains its foliage throughout the year, having a preference for limestone soils, and flowers during September and October; produces an abundance of seeds in short pods. Horses, cattle, and sheep devour it greedily, but of late years I have seldom seen it. The specimen was gathered near the Duck Ponds, Port Lincoln, inside a fenced-off piece of road, otherwise, no doubt, it too would have disappeared by being eaten out. Some allied species are poisonous, but I have never known injurious results from eating this one. Baron von Mueller, in the letter above-mentioned, also states that, in Gippsland, *Goodia latifolia* has been proved to have poisoned cattle. It would be interesting to know for certain whether the poison exists in the seeds or leaves. It often happens that a good deal of obscurity exists about poisonous plants and their effects, as they seem very uncertain. A friend of mine lately fed some old ewes on the undoubtedly poisonous *Euphorbia Drummondi*, but could not kill them, although he often loses an odd sheep or two from poison, and no other known poisonous plant exists on his property. I am inclined to believe that many leguminous plants reputed to be poisonous are not really so, but that an excess of either foliage or seeds eaten by a hungry animal throws off such an abundance of gases that "hoove," which is nothing more than an excessive distension of the stomach pressing against the diaphragm, preventing the lungs from working, and the animal is really strangled to death. To this cause I attribute all the deaths (and they are very numerous) caused by *Lotus australis var. Behrii;* really an excellent fodder plant, akin to the lucernes, but when seeding, and especially after rain, if hungry sheep are allowed to feed greedily upon it they die by hundreds, while sheep in confinement and fed solely on it do not die but actually thrive, as was proved some years since in Adelaide.

Kochia aphylla.—The Cotton Bush, so well-known and of such vast importance to herds and flocks in all our dry and very arid country. It belongs to the real saltbush order, and not like the two last described, which are only popularly considered so. It derives its popular name from the white cotton-like balls, the effects of a gall insect, very conspicuous indeed on a plant which so well deserves its scientific name of *aphylla* (without leaves), or sometimes present as mere scales. The plant usually presents the appearance of a round heap of reticulated green wiry twigs. It is most common on red clays and loams, espe-

cially where liable to occasional floods, and in the immense plains of the interior is a most reliable sign of those watercourses which, as they only become such at very long intervals, could hardly be traced but for this singular plant. Petals it has not, but the calyx is five-lobed, with a broad horizontal connate membrane. All kinds of stock are often largely dependent on it during protracted droughts, and when neither grass nor hay are obtainable I have known the whole bush chopped up and mixed with a little corn, when it proved an excellent fodder for horses. One drawback it has: its stems being very fibrous, and the older portions indigestibly so, it is the principal cause of those bezoars or felted knobs in the maniplus of the sheep, which in very protracted droughts kill them by hundreds. When, however, the rains come, and soft herbage is abundant, these bezoars either partially dissolve or become covered with a shiny-black coating, so that they then resemble a "papier-mache" ball. I believe the Cotton Bush attains a great age, and have often observed the extreme distance its fibrous roots spread. This is another of those plants which should never be ploughed up. As far as I have observed it does not commonly grow again, and has a greater value in its native habitat than anything which can permanently be grown there, and apparently does not seed freely.

Kochia sedifolia and *K. villosa*.—Commonly known as Blue Bushes. These grow on very healthy sound sheep country, but are not themselves good fodder plants. As a matter of fact, should they be eaten, the sheep must have suffered a good deal of starvation, and if they are eaten out, you may be certain sheep must have died in numbers. Before leaving *Kochia villosa*, it may be remarked that Baron von Mueller looks upon the Cotton Bush *(aphylla)* as merely a variety; but this is a case where we may look upon the sheep as a better botanist than ourselves, as both *K. villosa* and *sedifolia* seem to be very distasteful to them, and while we admit the exact similarity of the horny flower and fruit, I do think the extraordinary length of the roots of the Cotton Bush, as well as its difference in everything except the flowers and fruit, should entitle it to a distinct and separate position, and allowing this, I have observed two sorts growing near together mostly distinguished by the difference in the shade of their green stems, and in this case too sheep make a difference between them. Around Forbes, in New South Wales, I have seen another variety of *aphylla*; its young shoots drooped, were of a lighter green, and the small leaves or bracts more abundant.

Rhagodia parabolica.—This is another saltbush, which produces a good deal of foliage, and is not uncommon. Generally

found forming a low bush around some bigger tree; I have noticed it especially with *Leptomeria*. It is worth attention for cultivation. *R. spinescens.*—The same remarks apply to this species of saltbush also.

Chenopodium microphyllum.—A saltbush, like the preceding, often found protected by some larger shrub, and sheep care more for it than for many other saltbushes. It would be useful if growing freely; but experience must prove the best guide, as I think it possible some of the saltbushes will prove difficult to grow out of their own special localities.

Atriplex vesicaria.—This is one of the most common and widely-diffused of saltbushes, and is sometimes called the Small White Saltbush. This, I think, can readily be grown wherever the climate is not too wet. It covers very large extents of clayey plains, and in good seasons is only nibbled at by stock, excepting when covered by those curious vesicles which give name to the species. There is an annual sort much resembling it which unfortunately I have failed to determine the precise name, but the tops of the young plants are fairly edible when boiled, and together with *Tetragonia expansa*, or Native Spinach, have often afforded me a change of diet in the outside country. Before the vesicular seed vessels are quite ripe they make quite a loud report if trodden under foot.

Atriplex nummularium.—Often called the "Cabbage" Saltbush, from the comparatively large size of its leaves. It grows to over eight feet high, and is found commonly near to where water lies for some time; also on flats bordering the Murray that are rarely flooded. Eaten by sheep when food is scarce, not difficult to grow from seed, and adapted to form a contrast in shrubberies from having scaly grey leaves, and forms a dense bush.

Atriplex paludosum. — This saltbush is named from its favourite habitat, and may be readily distinguished from *A. vesicaria*, the leaves being much narrower and more erect. I mention it mainly to point out that not all the saltbushes are edible. This one in particular stock never eat if anything else is to be had.

Rhagodia Billardieri.—This small shrub is a very useful fodder plant, much eaten by sheep, although the branches are spinescent. It is mostly found on rich ground liable to floods, and is not very common here, although very abundant on the River Darling. From its habitat being restricted to flooded ground I do not think it worth cultivating. It should never be ploughed up, but, like all other of the best of the shrubs of which I have treated, it is imperative that sheep should not be kept constantly where it occurs.

Sarcostemma australe.—A very singular plant, named by Robt. Brown, the great botanist of Flinders' voyages, and described by him as a trailing twiner, but as found here it is a leafless mass of rigid stems three to four feet high, somewhat glaucose, scarcely so thick as a penholder. The stems, if broken, exude an acrid milky juice, but on the stony table-lands of the north-western district sheep have lived on this plant for months without water, and kept up their condition. The aborigines are also said to use it to prevent ulcerous sores from spreading. Like many more of the foregoing, injudicious stocking causes its complete destruction. In fact, all over Australia, wherever bushes of similar character to those described in this paper predominate, the extreme unwisdom of overstocking is most alarmingly evident, and each succeeding drought makes matters worse. The necessity felt by the sheep farmer to recoup heavy losses prevents his run being so lightly stocked as to permit of the young plants becoming established, with the result that each succeeding drought is more severely felt.

In concluding these remarks I hope some abler observer of plant life in the interior may publish notes, not only on our unsurpassed and exceedingly valuable grasses, which withstand drought in so remarkable a manner, but also on those very fattening herbs which cannot be surpassed in the whole world for their property of forming fat very rapidly, and of such a quality that stock travel enormous distances to market, and waste so slightly as to be able to surpass stock fattened locally. One such herb is that deliciously-scented clover, *Trigonella suavissima*, or Menindie Clover, which grows on soils subjected to lengthened inundations, such as Menindie Lake, and another is that useful vegetable *Tetragonia expansa*, or Native Spinach, very often boiled when garden-grown vegetables are scarce, and very many others, some of which may become of great use when cultivated beyond their natural limits.

It is very much to be desired that some one may also point out those plants, natives of the heated interior, which are likely to grow in the settled districts during summer, as I think it may be possible to sow with the seed-wheat annual grasses or succulent herbs which would grow during the hot weather, and after the grain is reaped. The immense advantage this would afford needs no enlarging upon; it would double the stock-feeding capacities of our farms, and I hope experiments in this direction by the able Professor of Agriculture at Roseworthy may be undertaken, as promising results of the greatest practical importance to all districts of the colony.

Boerhaavia diffusa.—In *Boerhaavia diffusa* we have one such plant—a perennial of straggling habit, with juicy leaves, often

lanceolar in shape, and when fading the underside has a characteristic pink hue. The Field Naturalists' Section found it near Noarlunga last summer. All sorts of stock feed upon it, and its trailing stems are found on many of the sandhills in central regions.

Claytonia Balonnensis.—This showy plant, called "Munyeroo" by the aboriginals, derives its secondary scientific name from the Balonne River, Queensland. It has a cluster of thick fleshy leaves, with a flower stem some six or more inches high, crowned with bright deep pink flowers as large as a shilling. Half an inch of rain, and it rapidly covers the sandhills. Cattle then leave the waters and feed on it, going without a drink for weeks together, and recently a large mob of cattle, destined to stock a Northern Territory run, travelled some 200 miles without a drink—a truly wonderful journey—and without this succulent herb altogether impossible. It is highly esteemed by bushmen and aborigines, and eaten either raw or cooked. Many others of the Central Australian vegetation are very interesting, and will repay a careful study, and some may possibly prove adapted for cultivation. One succulent plant, *Portulaca oleracea*, common to Europe, Asia, and Australia, may be found as a weed in our gardens, and is a useful sheep food in central regions, where its rounded, fleshy, jointed stems trailing close to the sand seem to luxuriate in heat, and to find the scantiest rain sufficient to give it vigorous growth.

In closing these very sketchy remarks, it may be hoped that as a knowledge of our native vegetation spreads, much advantage will result to the colony; for if our indigenous fodder plants are preserved, instead of being recklessly and wantonly destroyed, more good will result than by afterwards endeavouring to introduce new plants from similar climates, although in this direction also there is an immense field open of the most promising description, but as far as experiments have yet gone nothing exceeds, in practical use, our own native flora.

Notes on Iridescent Clouds.

By W. A. Jones.

[Read May 5, 1885.]

In some of the scientific journals attention has been lately drawn to the phenomenon of iridescence in clouds in daytime. The mass of correspondence on the subject may be assumed to have been started by the great amount of interest lately excited all over the world by the beautiful sunrises and sunsets, with the accompanying theories which have been propounded to account for them.

There has thus been a large amount of contemporaneous observation lately directed towards all meteorological peculiarities. Many of the observers have seen things new to them, and have recorded their observations as original, whilst in some cases the appearances observed have been misnamed, and the term "iridescent clouds" has been frequently applied to tints belonging to an entirely different class of sky colours.

I shall endeavour to show by evidence that the appearances which some observers have referred to unusual conditions are not new or unusual, but that they have been observed a long time past, and are of frequent occurrence, though they often escape detection.

It will be seen from the descriptions by others and myself that the clouds under notice are similar to those observed by Herschel in 1841, and described in his meteorology. I shall quote Herschel first. He says:—"The clouds were tinged with bands of colour, not in circular form around the sun, but following the sinuosities of the clouds. The colours commenced from the white area forming the interior, and proceeding outwards to the edge, were—1st, white; 2nd, very pale pink; 3rd, blue green; 4th, at the edge, purplish pink. These colours obviously had no reference to the greater or less proximity of the clouds to the sun, but depended upon the thickness of the cloud or the length of the path within it traversed by the visible rays. After watching for some time the bands grew broader and the tints stronger, with a tendency to form a corona. It seems impossible to regard these colours otherwise than as the resultants of the superposition of a series of interference fringes following a regular progression of breadth (due to a progressively increasing size of the drops) from the exterior to the interior of the clouds."

Similar clouds to these were observed and recorded at the

University Observatory, Christiania, in 1871, February 22nd, March 1st, May 10th; 1874, January 13th; 1875, February 17th; 1882, January 11th, February 22nd, July 13th; 1884, December 8th, 9th, 10th, and 12th.

The following is an extract from the observations of Christiania, January 11, 1882:—"At 3.30 p.m., sun having set at 3.20, extremely beautiful cirro-stratus iridescent clouds in south-west, at an altitude of 8° to 12° were seen. The upper borders, and later on the lower borders, were red, with yellow brims, the red of the borders and the inner parts were variegated, and very variable, resembling the red light commonly seen in mother-of-pearl. This changed through crimson into blue-green, and then into grass-green. The most striking cases of the phenomenon have been observed here when mild and dry weather set in after frost."

The extracts from my own notes also show that these clouds occur frequently. Thus:—

"In 1884, June 12, D.B., 78°; W.B., 67°; iridescent* clouds, and fine glow.

"June 15, D.B., 83°; W.B., 56°; iridescent clouds, beautifully tinted.

"In 1885, January 16, D.B., 80°; W.B., 61°; edges of clouds tinted pink, with green farther in. The red extended beyond the edge, like the red glow seen above the horizon; clouds of a heavy cumulus kind.

"January 26, D.B., 70°; W.B., 58°; iridescent clouds, very fine, all being high cirro-cumulus.

"January 28, D.B., 71°; W.B., 55°; barometer falling, very short glow in morning, faint clouds, and an ice-cloud halo visible nearly all day; the green very bright; clouds were very high cirro-films. Iridescent clouds seen about 10 a.m., just before halo formed.

"January 30, D.B., 80°; W.B., 60°; iridescent clouds like Herschel's present. The light appeared to be polarised in planes tangential to the sun; colours very varied. A fine pink halo existed round the sun.

"February 21st, D.B., 71°; W.B., 62°; clouds rather high, clearing off towards noon; beautiful pink halo round sun; iridescent clouds appeared; fine glow, and afterglow in the evening.

"March 9th, D.B., 71°; W.B., 58°; iridescent clouds of filmy character, halo very pink; splendid afterglow in evening; not very fine in the morning.

"March 10th, D.B., 75°; W.B., 61°; barometer falling, tem-

* In my original notes I described these clouds as Herschel's clouds but have here termed them iridescent clouds for the sake of uniformity.—W.A.J.

perature falling; splendid pre-glow, and glow in morning; peculiar streaky clouds coming up. Iridescent clouds at noon. Remarkable sun appearances at sunset—(see description in report of the Mathematical Society, Port Adelaide, 1885).

"April 17, D.B.,59°; W.B., 54°; max. temp., 65°; min. temp., 48°; m. bar., 30·46; very fine pre-glow and delicate change in colour of clouds, some being of transcendent beauty; filmy clouds formed, and became iridescent. Halo changed from pink to ice-halo. No glow in evening.

"April 22nd, D.B., 67°; W.B., 55°; max. temp., 75°; min., 52°; m. bar., 30·24; iridescent clouds; rather high clouds.

"April 30th, D.B., 66°; W.B., 52°; max. temp., 76°; min., 50°; m. bar., 30·32; cirrus clouds, rather heavy; beautifully iridescent at various times.

"May 1st (see account of notes further on)."

The dates on which these notes were taken show that the iridescent clouds are not specially connected with any new factor in meteorology, and that they are not connected with any particular kind of sky glows, unless, indeed, glows are connected with some peculiar form of water, and that the conditions required for glow appearances render the existence of iridescent clouds more or less possible.

The recorded observations of many persons are such that they must have mistaken portions of ordinary cloud halos for iridescent clouds, as the descriptions given in their cases are actual descriptions of halos in different positions, with the misnomer, "iridescent clouds."

There are various apparent changes in breadth of the limb of a cloud halo, as its distance from the horizon varies, that render it very possible for an inexperienced observer to fail in recognising a halo in every portion. It is important that future observers should discern the difference between the two classes of phenomena; and the two appended descriptions are therefore fully extracted from my meteorological notes.

Note 1st.—April 17, 1885. Readings are for the previous twenty-four hours—Dry bulb, 59°; W.B., 54°; max. temp., 65°; min. temp., 48°; mean bar., 30·46; barometer falling slowly; temperature rising. Most beautiful sunrise and pre-glow; very fine change of colour, first from the higher clouds, when cross polarization was evident. Then the lower clouds became illuminated in a beautiful manner with various tints, all tints ending in a yellow, after which clouds became white. The clouds, all of a delicate nature, became iridescent when near the sun about 10 a.m. The colours bore no reference to the angular distance from the sun within certain limits; thus the colours were not observed in the cloud patches, whose angular distance from the sun exceeded that of the limb of the pink

halo visible at the same time. This halo was beautifully clear and merged into an azure sky. The cloudlets, or cloud-patches, as they approached this pink space became variegated with most beautiful tints. In some cases these tints seemed to follow roughly the sinuosities of the clouds, pink being always at the edge. This pink was brighter than that of the halo into which it merged. The character of the clouds was that of cirrus, or cirro-cumulus. The structure was very delicate, resembling filaments of cotton wool in very loose heaps, with changing iridescent hues. As the clouds approached the sun they got brighter in colours, and as they got within about 6-8 degrees from the sun the edges nearest became tinted with the ordinary colours seen so frequently round the moon, and also round the sun when it is viewed by reflection from a surface of water contained in a vessel deep and black. The iridescent tints observed were pink, green, blue, orange, and mauve; pink being in all cases at the edges. As the clouds coming up, or forming, changed in character to that of cirro-stratus, the colour of the pink halo changed and had a colder tint, until it became overclouded with cirro-stratus. By this time there was no pink halo, but its limb had been gradually becoming more sharply defined and bright, so that by noon it had assumed the definite limb of an ice-cloud halo. As soon as the clouds had taken the character of cirro-stratus completely, the whole phenomena of iridescence ceased. In the evening there was no glow proper, but the clouds becoming a little thinner the halo assumed a pinkish hue. Cross-polarization was observable before sunset. There was a greenish twilight, though not so clear as it is when the clouds are lower and a low pressure area is approaching from the west.

The second note relates specially to the rare phenomenon of a double halo.

Note 2nd.—May 1st, 1885. D.B., 67°; W.B., 53°; max. temp., 75°; min. temp., 50°; m. bar., 30·26. Barometer falling slowly. Wind E.N.E. A bright sunrise; sky full of various tints from very high clouds. Character of clouds, cirrus and cirro-stratus, the colours of the clouds augmented by cross-polarization. At 8.30 a cloud halo was observable, being very perfect, and nearly circular to the sun. The colours, as seen in order from the sun, were red, orange, yellow, green, bluish; the angular distance from sun varied from 18° to 23°. There was a second halo at an angular distance of about 46°, not quite so central as the smaller one. The distance was measured. The colours were in same order as the first series. Both the rings existed until 10 a.m., when the outside one vanished, and the clouds became thicker. The inside halo of about 23° lasted all day, with varying degrees of

clearness. The field within it was notably darker than the surrounding portion, which was lighter even than the sky beyond. The limb of the halo became wider as the sun approached the horizon. Presently the underneath side blending, vanished, whilst the remaining portion could well be mistaken for an iridescent belt of cloud. This at last became quenched by the brilliant crimson clouds. No glow existed. Moonlight during evening displayed a similar halo.

It will be seen from the two descriptions just given that frequent mistakes might be made in taking a portion of some halo for iridescent clouds; and as the character of polarization is very obscure, it is almost impossible to distinguish the difference by the aid of the polariscope, and experience in the various forms the halo assumes becomes necessary.

In many instances short pieces of rainbow might pass for iridescent clouds, but they can be instantly detected if viewed through a nicol-prism, as they can be completely quenched with the nicol-prism in radial position.

*The following note is important, as bearing directly on this part of the subject:—A tinted sunrise; sky overcast, with clouds and patchy colours to north-east, but to the west there was a fine exhibition of tinted clouds. The fine high clouds were tinted pink, and their light was polarised in planes passing through the sun, the clouds, and myself. Near the east no change was produced when the nicol-prism was rotated. The colour of the clouds was pink, and very bright towards the west portions of sky, opposite to the sun, which had not yet risen above the horizon to my sight; and a phenomenon existed that might easily have been mistaken for an iridescent cloud. A band appeared, with red to the outside and green to the inside of the circle of which this band formed a part. The inside area of this circle was tinted red, and it was nearly as bright as the red of the portion of ring described. This ring was evidently part of a rainbow, for the nicol-prism completely extinguished it when the long diagonal was at right angles to its circumference. But what was more important was the fact that the red within this ring, and also the red without—though there was not much outside—suffered extinction with the nicol in same position. It occurred to me that if the nicol were directed to the different points of sky corresponding to the position of the unseen rainbow, the light of the red haze would be extinguished with the diagonal of the crystal at right angles to the tangent. Trying this, I found it to be the case.

This is an important note, because of the character of polari-

* This note was inserted after the paper was delivered.

zation discovered. The note was taken at Gawler, and I found that at the very time this appearance took place the plains to the west were receiving a heavy rain.

It follows from this that there are several forms of apparent iridescence: the halo forms, rainbow fragments, and the true iridescent clouds; and it is necessary to distinguish between them if we wish to learn much respecting the true iridescent clouds.

The limits of position of such clouds are, in reference to the sun, evident from the notes. Thus they are seen furthest from the sun both at sunrise and sunset, and closest at noon. They are always within the limits of the pink halo, and this is noticeable in connection with the remarkable change in the dimensions of the pink halo from day to day, and from morning to evening, the pink halo being more extended at morning and evening.

When there are two layers of clouds the iridescence does not appear whilst the sun has a great altitude and whilst the one layer of clouds is between the sun and that layer from which the iridescence comes. But on these occasions the iridescence appears when the sun is lower; and then, when the clouds that can become iridescent are illumined at the proper angle, the upper clouds are in such a position that their most illumined portion is not in a line drawn from the eye through the iridescent clouds. At these times the iridescent clouds are most noticeable, owing to the amount of light and the darker background.

The statements here made are corroborated by other observers—Prof. A. S. Herschel, of Newcastle-on-Tyne. T. W. Backhouse, writing of his observations, says:—"Iridescent clouds have been seen at all times of the day, but they have been most strikingly noticeable near sunrise and sunset. Colours don't appear when the clouds are far from the sun, they being then only white during day. * * * * At about half an hour to sunset iridescent clouds have been seen."

J. Graves refers to colours in the clouds like rainbow tints, but not regular, and having considerable altitude, at 26 minutes after sunset.

The reports from Christiania Observatory refer to the great distance of the clouds from the sun at sunset.

These notes show that in all places where iridescent clouds have been noticed they can be best seen when the sun is below the horizon, or when it is somewhat high in the heavens, the iridescence rarely appearing when the sun is just above the horizon. Their relation to particular cloud forms is indicated in many of the preceding notes. Thus they generally seem to precede clouds that come up and take the filmy form, from

which the ice halos appear to originate, as my notes show more conclusively than any other notes do. The relation of iridescence to similar clouds in other places than South Australia is shown by the following reports:—

Piazzi Smyth, writing from Edinburgh, says of the brilliant iridescent clouds of December 11, 1884—"Part of the time the iridescent clouds were eclipsed by a heavy cumulo-strata cloud, which showed clearly that the iridescent clouds were cirrus clouds, not as high though as the cirro-stratus haze, acting as a background to show off the beauties of the blue and green iridescent clouds."

The report from Christiania Observatory, already quoted.

The continuation of T. W. Backhouse's remarks. He says:—"The colours appear to be related to thin sheets of cloud-haze, which is white, and not coloured at a great distance from the sun." He describes the iridescence as being on a dense pallium of cirrus clouds. There are other reports supporting these, but it is needless to quote further.

The relation of iridescent clouds to states of weather is also indicated by notes that I have been able to make, and by reports of others. Their appearance is most prominent in all places during the cool months and on those occasions when fine ice-clouds are likely to be forming, or when they have been just disappearing. In Christiania they have been usually observed when mild and dry weather set in after frost. Corroboratory notes come from Prof. A. S. Herschel, T. W. Backhouse, and Piazzi Smyth. Miche Smith, of Madras, states that the appearance of iridescent clouds there is usually noticed before the approach of the monsoons, and these clouds are looked upon as a sure sign of monsoons being near at hand. These periods are the cool periods.

In reference to the spectrum and absorptions, it is sufficient to say that on all occasions the absorption lines have been indicative of dry atmosphere when the sky near the sun has been examined, the blue end of spectrum being relatively brighter, as it generally is when the air is somewhat dry and cold. The tints of the sky are numerous, and each tint has its own particular spectrum, so that a complete account of the tints in the various parts would require a special paper. The only point of value is that the air seems somewhat dry, and that the blue end of the spectrum is relatively brighter, indicating a cold upper stratum. This note only applying to my observations in South Australia.

Methods of observation:—I have tried many ways of observing these clouds. They can be viewed by reflection from substances that absorb part of the light. Thus water contained in a black vessel; surface of black glass; coloured solutions.

Water is best where practicable. It should be contained in a deep vessel, so that most of the water is in a deep shade. The colours can be seen very well in this way. In many cases it is preferable to use dark glasses of a neutral tint, as they can be used anywhere. The best way to use them is to stand in the shadow of some building so as just to hide the sun. Then with the aid of dark glasses the brilliancy of the sky is sufficiently reduced to enable the observer to distinguish the colours clearly. A very valuable method consists in the use of nicol-prisms and selenite film, thus obtaining any desired tint as background, and allowing one tint at a time to appear from the clouds.

Past Climatic Changes, with Special Reference to the Occurrence of a Glacial Epoch in Australia.

By Gavin Scoular, Corr. Mem.

[Read July 7, August 4.]

[abridged.]

Introduction.—Of the many complex problems with which the South Australian geologist and scientist have to deal none probably are more shrouded in the hidden mysteries of nature than those to which the above heading refers. That the formation known as the "drift deposits," constituting the Adelaide plain and other places, was a consequence of those climatic changes which were embraced by the period of the last glaciation of the southern hemisphere, I think geologists who have thoroughly studied these beds are fully agreed; but whether they, especially those comprised along the western seaboard of the colony, were laid down whilst the Australian Continent stood at a much greater elevation than now, or whilst in a more depressed state than it now is, is a subject worthy of careful investigation.

Traces of a Glacial Epoch in South Australia.—Instances of supposed ice markings, arising from the effects of actual glacial action or otherwise in connection with the Adelaide chain and adjacent seaboard, have been observed and noted from time to time by various geologists. Mr. Selwyn ("Geological Notes of a Journey in South Australia," p. 4) directs attention to a point in the valley of the Inman where he says:—"I observed a smooth striated and grooved rock surface presenting every indication of glacial action. The bank of the creek showed a section of clay and coarse gravel, or drift composed of fragments of all sizes irregularly imbedded in the clay. The direction of the grooves and scratches is east and west in parallel lines, or nearly at right angles to the strike of the rocks, and though they follow the course of the stream, I do not think that they could have been produced by the action of water forcing pebbles and boulders detached from the drift along the bed of the stream." Mr. Selwyn likewise notifies that this was the only instance of the kind he had seen in Australia, and though somewhat struck with the similarity of the markings to those he had formerly seen as ice markings in the mountain valleys of North Wales, he seemed, nevertheless, to retain a doubt in

his mind as to whether or not the scratchings he had seen impressed upon the rocks in the bed of the Inman had not at some former period been effected by the agency of running water. This latter hypothesis I am inclined to consider the most probable. As to the whole subject of these supposed ice markings I will endeavour to treat of more in detail subsequently.

The Rev. J. E. T. Woods ("Geological Observations in South Australia," first edition, p. 20), in treating of the geology of the Adelaide chain, says:—"In examining portions of it I have been led to think that probably they were of much greater height at one time. Indeed, it seemed to me, so far as a cursory examination could guide me, that there were very distinct marks of snow and the action of glaciers. This would declare the range to have been once of extraordinary elevation, probably the axis of some former continent."

Professor Tate, in his annual address to the Adelaide Philosophical Society, 1878-9, while treating of traces he had observed of former ice action in South Australia, (1) instances the grooves and scratchings observed by Mr. Selwyn in the bed of the Inman. "Smooth, grooved, and striated rock surface and moraine *debris* at Black Point, forming the southern boundary of Holdfast Bay." (3) "South of Field River, moraine *debris* and masses of transported rocks strewn over the top of the cliffs." (4) "*Roches moutonnées* surfaces of the mica slate on the south flank of Kaiserstuhl, and similarly large rounded surfaces at Crafers; both localities in the Adelaide chain." (5) Also an ice-worn pebble from the River Torrens drift, obtained by the late Sir R. D. Hanson. (6) And likewise near the gorge of the Torrens River there is a stream of *debris* extending along the side of the hill, which the Rev. J. E. T. Woods considers to be the remnant of a former moraine, and in the bed of the river a block of rock is situated, the sides of which are indented with striæ similar to that imprinted by ice action. "Such," the Professor adds, "are the signs of the former existence of ice action in South Australia;" and propounds the following theories as to how this excessive cold might have arisen:—(1) "The prevalence of a very much colder climate;" or (2) "that the land stood at a much greater altitude (say 10,000 feet), or the mountains may have had a more plateau-like form, and therefore need not have been so high, and consequently collected more snow;" or (3) "A combination of both." By these remarks the reader would scarcely know what opinion the Professor holds; but if he turn to the following page of the address he will, I think, be convinced that then, at least, the Professor was of opinion that the elevation of the Australian continent, and that only, had been the primary cause which led to the appearance of glaciers upon

the shores of Australia. I am given to understand that since the publication of his geological work on South Australia the Rev. J. E. T. Woods has seen fit to change his mind about the occurrence of a glacial epoch in Australia, and concludes that under the circumstances, and the present acceptation of the term, that it was impossible for a glacial epoch to have occurred in these regions. Returning, however, more particularly to the supposed ice striæ at Black Point, and assuming that the striæ on the surface of the stone there were effected by the passage of land ice, these seemingly ice-striated scores on its surface are impressed upon it in the direction of south and north, and *vice versa*. Guided by this fact, and presuming that the strata upon which the striated block reclines was at the time when the markings upon its surface were effected raised to an elevation of something approaching from 12,000 to 15,000 feet above its present altitude (an elevation of 10,000 feet is not sufficiently great to maintain glaciation either now or during the period of the drift in the neighbourhood of Holdfast Bay). If such had been the case, it is perfectly obvious that the area now occupied by St. Vincent's Gulf must have then been wholly filled with land ice. Therefore the glacier, if it was one, that left its supposed ice impressions upon the stone at Black Point was not by any means pursuing its most direct course to the sea; for according to the direction of the impressions left upon the stone, the glacier's path must have been either north, which is directly inland, or south, which was not at all likely, because in that case the glacier would have had to contend against and surmount the source from which it originated. Whatever may have been the primary origin of these striations, in a great measure at least they must now be confined to the realms of conjecture ; yet, after fully considering the whole circumstances in connection therewith, I am led to believe that the furrowings in question were not produced by the action of land-ice. The phenomena, in all likelihood, might otherwise be referable to the original chemical inequalities in the character of the stone itself, the softer parts, after its exposure to atmospheric influences, yielding in a somewhat greater degree to the action of the north winds, and surcharged as these winds most frequently are with silicious sand, the furrowed markings upon the stone, and the path of these winds being in direct parallelism, suggests a hypothesis that the markings may have arisen in the manner described.

Then as to the fact that erratic boulders have been found sparingly strewn over the land surface in the locality of Black Point, and, also, a few, on rare occasions, have been discovered in other parts of the colony, chiefly near the present coast-

line. In connection with this subject it might be well to consider that during the peroid of extreme glaciation of the southern hemisphere, the permanent frost-line would stand from eight to nine degrees nearer our shores than it does at present, which would facilitate the passage of icebergs northward to a similar degree as the permanent frost-line extended in that direction. At the same time the eccentricity of the earth's orbit was at a high value, according to Dr. Croll's theory, and cold greatly predominating in the southern hemisphere, whilst the southern shore-line of South Australia we may suppose as submerged to the extent of from 800 to 1,000 feet. Judging from the dimensions of icebergs, noted by navigators in the Southern Ocean at present, the southern shore-line of Australia would then just be about the depth at which bergs of such dimensions might be expected to strand. The watery parts of which they were composed would soon give way to the action of the surrounding warmth, which would be considerably above the freezing point; consequently, the more coherent materials of these stranded bergs would soon drop to the bottom of the sea, and as the land rose the greater portion of this transported *debris* would emerge with it, as a puzzle for the future geologist to determine its origin. It is not at all improbable but that some, at least, of the boulders transported in this manner may have been striated by the action of ice on lands far away, long ere they started on their journey to be exposed afterwards on a distant Australian shore-line.

In his geological work on South Australia the Rev. J. E. T. Woods, (since the date in question I believe the rev. gentleman has altered his mind on the subject of Australian glaciation)—attributes the primary cause of the glacier action he had observed in the Mount Lofty Range to the great altitude of the chain during the glacial epoch. If any extraordinary elevation of the chain ever existed, it must have been long anterior to the date of the glacial epoch to which the rev. gentleman refers. The pre-Silurian rocks, constituting the Adelaide chain, since their deposition have been subjected to vast contortions and denudations; nevertheless, I can discover no evidence to show that the chain ever attained a much greater altitude above sea level than it now attains. It seems to me a much more probable hypothesis that the axial elevation of the range was first determined by some slight undulation of the beds, and for ought we know might have arisen in the ancient sea-bed, which by a succession of upheavals ultimately would become dry land. Denudation then would begin to operate, and the slowly-rising land soon afterwards would become furrowed into inequalities, and as the slopes of the first undulations enlarged, the primary sketch of a mountain chain, with rivers, gullies, and gorges, would be developed.

The relation and position which the younger South Australian rocks occupy upon the upturned edges of the old pre-Silurian beds are against the supposition of any very decided change of sea level since the deposition of the former. It will be recognised that no decided movement, either by way of depression or elevation, can have taken place throughout the area of the Mount Lofty pre-Silurian rocks since the deposition of the Yorke's Peninsula lower Silurian beds. These rocks, as exhibited there, are resting almost in a horizontal position upon the upturned edges of the pre-Silurian beds. The seemingly massive character of the beds and the manner of vertical fracturing, indicate to my mind at least that no general movements have occurred, either elevative or depressive, throughout the locality since their deposition. The same considerations are applicable as regards the horizontal condition in which the Miocene beds of South Australia are invariably found resting. Therefore, judging by the undisturbed condition of both the earlier and the later formations, leads me to infer that no upheaval has taken place in the neighbourhood of Adelaide sufficiently important to produce general glaciation of the surrounding country since before the deposition of the lower Silurian beds of Yorke's Peninsula.

According to Dr. A. Geikie, the line of perpetual snow in the Himalaya mountains is 19,000 feet above sea level. These mounbeing situated in latitude 22 degs. north, in round numbers, let us say Adelaide is situated in latitude 35 degs. south, by the same ratio Adelaide would require to be raised to the elevation of 12,000 feet above sea level in order to bring it within the influence of the permanent frost-line. Presuming Mount Lofty to have stood at about the same height above the Adelaide plain at which it now stands, in that case the mount would require to have stood at an elevation of nearly 11,000 feet above the plain to have brought it within the influence of perpetual frost, which height would barely meet the requirements of the theory propounded by Rev. J. E. T. Woods; and much less would it have maintained glaciers at the present coast-line. An elevation of quite 2,000 feet more would be required to have brought these parts within the influence of perpetual frost; for, as already stated, Professor Tate and others have detected signs of former glacial action in the vicinity of our present coast-line. Besides, had any portion of Australia been elevated to the extent of 12,294 feet about 150,000 years ago it could not have been of local application; it must have extended pretty generally over the entire southern portions of the continent of Australia. Had it been otherwise the drainage of the present river systems would have been completely altered by such movements, but which, from evidence

obtainable we have every reason to infer has not transpired, at least since before Miocene times.

Evidences of Submergence during the Last Period of High Eccentricity.—Having already pointed out the great improbability that the southern shores of South Australia were invaded with land-ice during the last glacial epoch, I will now endeavour to note a few of the evidences I have collected showing that the seaboard of this part of Australia at least was submerged when extreme cold last prevailed in the southern hemisphere to an extent of over 800 feet.

I am fully convinced that our so-called drift formations, extending at least to an altitude of 800 feet above present sea level, are chiefly of marine origin, and were deposited during the period whilst the last high state of eccentricity prevailed, and whilst the southern hemisphere was passing through its long secular winters of the period. In support of this hypothesis I may state that in well exposed sections of the deposits I have noticed the general characteristics which lead me to infer that the calcareo-argillaceous beds were deposited in comparatively deep and still waters, and which could not possibly have been the debris derived from the meltings of land-ice.

Where the streams from the hills have cut channels through the deposits so that the base of the formation is exposed to view, boulders and pebbles occur, presenting evidence of their having been beach worn. Such water-worn boulders and pebbles I have especially noticed occupying the base of the deposits in the gorge of Smith's Creek and in other gullies where the base of the formation is fully exposed throughout Munno Para East; also from the debris of a well evidently penetrating the basement beds of the deposits. On the western side of the Hummock Range boulders and pebbles of a most decided shore-line aspect have been seen by me also.

At considerable distances from the adjoining hills, imbedded in these calcareo-argillaceous deposits, specimens of drift-wood have not unfrequently been found, belonging to the same species still inhabiting the surrounding heights, which also militates against the theory of the actual glaciation of South Australia during the deposition of the drift deposits. For, as well known to botanists, none of the species of our gum tribe are adapted to withstand the rigours of severe cold, and I am of opinion also that few or none of the species of the land fauna would have withstood the severe change perpetual frost entails. The "Transactions of the Royal Society of South Australia," 1880, pages 27-28, states that nearly every species of our existing fauna lived during the period referred to. As to the appearance and extension of the *Diprotodon australis*

and similar congeners during the period, permit me to remark, it was not the actual ice-clad condition of the land surface, but a greater annual rainfall which Australia enjoyed that ushered in these creatures upon the scene. A greater rainfall implies that a more exuberant vegetation than we now possess was spread over the landscape, and following the laws of evolution, a race of animals in every way more powerfully developed is evolved to utilise it.

Inter-glacial, or Pluvial periods—probable date of and duration.—It is now admitted by geologists and scientists generally that the last glacial epoch was periodically interspersed by warm intervening periods of heat. There is indubitable proof from the interbedded character of the seaboard deposits, that during the period of the last glaciation of the southern hemisphere vast climatic changes occurred. As a sample of the many evidences which might be here cited in favour of that view, I will only instance a few which have come more prominently before my notice.

Near Penfield, in the Hundred of Munno Para, section 3,170, a stratum of gravelly material was discovered at a depth below the present surface of from eight to ten feet, interbedded in the calcareo-argillaceous deposits of the Gawler Plains. The locality in which these gravels occur evidently show that they were laid there whilst Australia was enjoying a much greater annual rainfall than prevails at present; and, also, that the sea level was considerably higher than it now is. Likewise, in the same hundred, section 3,160, about 24 or 25 years ago a bed of gravel was struck in an effort made to obtain water, about 20 feet below the present surface, which was also proven to be overlaid and underlaid by the usual calcareo-argillaceous deposits of the plain. Gravels and highly water-worn boulders are also to be seen exposed in the gorge cut by the waters of Smith's Creek in sections 4,158 and 4,161. In this section at least two beds of gravel are exposed to view, the uppermost being again overlaid with from 12 to 20 feet of calcareo-argillaceous material. In section 3,178, Hundred of Munno Para, about eleven or twelve years ago, whilst excavating a water-tank, after penetrating the calcareo-argillaceous subsoil characteristic of the plain, at a depth of about six feet below the surface a bed of gravel from three to four feet in thickness was struck, at the base of which indubitable evidence was shown that a fire not only had been lit there, but that it had been kept in an active state of ignition for a considerable period of time from the large quantity of ashes still remaining within the enclosure of a few stones collected together to constitute the primitive fireplace. Here evidence is forthcoming referring to two branches of physical science. (1) The pre-

sence of the gravel bed resting between the calcareo-argillaceous deposits supports the idea that the Gawler Plains not only enjoyed a much moister climate than they now do; and, also, that their relation to the sea level at the period must have been very different from what it was either before or after the event. (2) The excavation also proves that the aborigines of Australia had at that period entered upon the scene; and at that early date of their occupancy they had become sufficiently knowing to erect a rude circle of stones around the fire so as to retain the heat.

As further proof of the interstratified condition of the formation in Gawler West, whilst the late Mr. T. Munroe was engaged in the excavation of a large tank for the purpose of storing rain-water, after passing through from eight to nine feet of the semi-clayey deposits characteristic of the subsoils of Gawler Plains, a bed of gravel was struck, which impressed me forcibly at the time of its having been caused by river action, and, if so, it is evident that the channel of the South Para—a little to the west of its outlet from the hills—then flowed over the plain rather more than 200 yards to the south of its present course; and that its channel was then about 30 feet higher than the level of the bed of the present stream. Similar illustrations may be found in sections given in various papers published by the Royal Society of this colony.

Probable Date of the Last Glacial Epoch.—At the time when I penned my brief sketch of the "Geology of Munno Para" I was under the impression that the last extreme glaciation of the southern hemisphere in point of time had preceded the epoch in the northern hemisphere known as the glacial, and its intensity had begun either about 980,000 years since or about 720,000 years ago. But after reconsidering the subject more carefully I arrived at the conclusion that it must have been in connection with the last term of high eccentricity that a glaciation of the southern hemisphere occurred, which, according to Dr. Croll, took place between 240,000 and 80,000 years ago. At that period a high state of eccentricity continued for a term of 160,000 years, which according to the laws governing the precession of the equinoxes, each hemisphere would pass through during that term about eight periods of extremes in cold and heat. The diversiform character of the summers and winters which then must have prevailed would lead to a much greater rainfall than is now witnessed over the Australian continent, and which would continue in a state of greater or lesser intensity for about 10,000 years respectively.

A Glacial Epoch at the Close of the Miocene Period.—Scanty but indubitable relics are left to show that the continent of Australia was affected by cosmical changes

at the close of the Miocene epoch, in a similar way to that which took place at or near the close of the Pliocene period. Though the evidence be somewhat defective, I will here state that the beds known as the "Upland Miocenes" are partly of marine origin, and partly fluviatile and æolian. Therefore whilst the beds were being added to the series by the influence of the two last-named conditions, a vast difference in the temperature of the Australian climate must have prevailed from what we now witness. In the indubitable marine beds at Aldinga Bay and the Murray Cliffs, the more delicate, or what we might term the more tropical species of the fauna, gradually disappear throughout the lower beds of the formation, until at either place the uppermost fossiliferous bed in the series is entirely restricted in its fossil remains to a species of oyster, and that, too, I am credibly informed, is not at present an inhabitant of South Australian waters. Thus a study of the marine beds in question teaches—Firstly, that as the cold was gradually setting in, the molluscan species which are most indigenous to tropical waters disappeared from our shores. At last even the oyster, which is considered to possess a wider geographical range than many other of the molluscan genera, succumbed to the rigours of the increasing cold also. At both localities the bed is overlaid by one known as the non-fossiliferous Miocene clays. These non-fossiliferous clays arose from the azoic character of the waters of the surrounding seas of the period; and that the deposits of a sandy nature, found sparingly distributed throughout the bed, are the æolian accumulations of the period there can be little doubt. As the deposits ascend in height above present sea level the æolian constituents become more prominent in character, until they reach an altitude of about 1,100 feet, when they become, so to speak, the equivalents in time of the calcareo-argillaceous beds of the Adelaide, Gawler, and other seaboard plains.

I have been led to conclude that the whole deposit, in part sub-marine and in part sub-aerial, was formed whilst our earth was passing through one of its periods of high eccentricity, and consequently this change for the time being of the earth's pathway round the sun would naturally lead, in certain latitudes at given periods, to an excessive amount of rainfall, and at others excessive drought; and such extremes of secular change would also lead to a corresponding amount of geological disintegration, and it was during such a period, as it seems to me, that the non-fossiliferous Miocene beds in the neighbourhood of Adelaide and other kindred Australian deposits were developed.

Why the Seaboard Drifts of South Australia are Void of Marine Fossil Remains.—Profound depths and varying tempera-

ture of the sea, as is well known, as effectually barricades the free passage of many of the higher orders of marine life from the shore-line of a continent or island, in which they are not native, as high altitudes constitute a line of demarcation to the terrestrial fauna inhabiting two separated plains of a great continent. In this way it is quite possible under favourable conditions that change of temperature alone may depauperate marine life, or may even give an azoic appearance to deposits which are of marine origin. The evidences which have led me to these conclusions — that the South Australian seaboard recent accumulations belong to that class of deposits—are summarily stated in the following sentences :—

Mr. A. Wallace states ("Distribution of Animals ;" vol. I., page 447) :—"Between the Fiji Islands, New Caledonia, the Solomon Islands, and Australia, the depth is about 1,300 fathoms, and between Sydney and New Zealand 2,600 fathoms, showing in every case a general accordance between the depth of the sea and the approximation of the several faunas." By referring to a map of the world showing the undulations of the ocean bed, it will be seen that the continent of Australia is surrounded on the south and west sides by a depth of water which at no point is less than 15,000 feet. The sea depth between New Zealand and the islands to the north as well as between New Zealand and the continent of Australia, up to the 25th degree of south latitude, is not less than 15,000 feet, whilst the depth between New Zealand and Sydney is 600 feet more. According to the facts relating to the distribution of life in abyssal depths, as supplied by the Challenger reports, we might infer that little or no direct intercourse can take place at present between the molluscan fauna dwelling in the shallower waters around New Zealand, or her satellites, and the south and east shores of Australia. Also, if we examine the physical and palæontological aspects of these countries, we are led to believe that these conditions not only at present exist, but that a similar state of sea depth prevailed between those countries throughout a vast period of past geological time. Consequently when extreme glaciation pervades the southern hemisphere, a barrier is not only thus set up against the direct passage of the molluscan fauna that inhabit the shores of New Zealand and the islands connected therewith, and the more temperate shores of southern Australia, but it also prevents the free intercourse of the oceanic fauna (if there be any) that inhabit the shores of Victoria and those of New Zealand.

Depending upon the consideration that no very great difference has arisen in the relationship of sea and land within the Australian area since the period of the last great glacia-

tion, I am led to conclude that, as the insetting cold advanced towards the equator, the semi-tropical fauna then inhabiting the South Australian area would migrate or creep northward, as their natural habitat receded in that direction; and from the profundity of sea-depths which separate adjacent lands from the southern shores of Australia, the South Australian shores would remain depopulated of the higher orders of mollusca so long as this state of cold prevailed. As the cold reached its severest point the sea increased upon the land in the latitude of Adelaide to the extent of from 800 feet to 1,000 feet, and the deposits laid down in that azoic sea when elevated into dry land would assuredly be void of most if not all indications of marine life.

That a somewhat similar phenomenon occurred during middle Tertiary times might have been noted, and that one or more of the species common in the Miocene beds of South Australia migrated northwards at the close of that period and are now found inhabitants of the tropical seas.

It would appear that a somewhat similar theory arose in the mind of Mr. Selwyn to the one I have advanced. He states at page 25 of his "Physical Geology and Geography of the Colony of Victoria":—"The absence of any evidence of marine life may probably be fully accounted for by the character of the deposits, which indicate physical conditions that must have been highly unfavourable to the development of animal life in the area." According to this quotation it seems that the same non-fossiliferous conditions extend throughout the recent deposits of Victoria as prevails in South Australia. Being assured then that so great a similarity prevails *palæontologically* throughout the recent deposits over so widespread a tract of the Australian continent, suggests that these effects were produced by some equally widespread a cause.

By reference to a map of the world we observe that no analogy exists in the distribution of sea and land in the northern and southern hemispheres. In every case the continents that are situated within the former enjoy a diversity of temperature such as that hemisphere sustains; consequently the inhabitants of these lands and the adjoining seas have free access to accommodate themselves to that degree of temperature best adapted to their wants. If the cold of the frigid zone for a time be extended equatorwise, the inhabitants, both of land and sea, of these regions have natural facilities afforded to shift their area of occupancy; or if the heat for the time being of the torrid zone incline towards the north the abode of the inhabitants of these regions is similarly extended. In short, throughout the northern hemisphere, at whatever parallel of north latitude the permanent frost-line may be

situated, the littoral, or shore-line inhabitants of the adjoining seas have free access to migrate from north to south, and *vice versa*, in such a manner as to follow the isothermal conditions of their wonted habitat.

Such accommodations, however, are not applicable in every case with regard to the inhabitants of the continents situated in the southern hemisphere. It is true the marine fauna bordering the shores of Southern Africa, America, and Australia have in each case free access to migrate northwards in the event of the isothermal conditions in the southern parts of these continents getting colder. But so far as Africa and Australia are concerned, at least, considering the great expanse and ocean depths that are situated to the south of these countries, it is questionable if the existing fauna were driven northwards by an increase of cold, whether the breaches thus caused in the ranks of animal life in these regions would be immediately replenished by others indigenous to a colder habitat. With regard to Australia, New Zealand might be looked upon as being a sort of halting place in the passage of marine life passing between the frigid waters of the antarctic circle and those of a more temperate character which encircle the southern shores of Australia. But if the depth of sea be considered which lies between the shores of Victoria and New Zealand, it becomes almost an impossibility that such a highway could have been available for the migration of animal life during the time of the last extreme glaciation. The resembling character existing between the non-fossiliferous clayey Miocene beds, also the upland Miocenes, and the more recent deposits constituting our seaboard plains, forcibly show that all were originated in a similar manner.

Since the foregoing was written I have revisited the grooved and striated rock surface at Black Point, Holdfast Bay, and from what I then saw and could determine, the views as stated in this paper regarding the phenomena were fully substantiated. On the top of the sea-cliff, where the surface of the bed-rock has been exposed to the action of the north winds and that of the sea for centuries, the grooved and striated rock-surface rest, and consists of a bed of hard, slightly micaceous, schistoze rock, occupying very nearly the anticlinal apex of one of those minor folds of so frequent occurrence throughout the pre-Silurian rocks of South Australia. The strike of the bed upon which these interesting striations are impressed is in a parallel direction with the furrowings, which are south-south-west by north-north-east, and dip at an inclination of from six to eight degrees to the west. Another peculiarity I observed on revisiting the scene of these striations (which, to my mind, have

a tale to tell against their being of glacial origin) is that the striæ on the rock-surface in no case are prolonged below the recent deposits, unless where they are of sub-aerial origin. Such proofs strongly lead me to believe that the striæ in question are not of ice origin, but were effected by other agencies at a period subsequent to that of the last great ice age.

As a further corroboration of the opinion that these striæ on the rock-surface at Black Point are not of glacial origin, on revisiting the locality I discovered about fifty yards north-easterly, in the bed of a small stream, similar markings to those observed at Black Point, showing evident signs of their having been effected by atmospheric and aqueous agencies; with this marked difference, however, that they were impressed upon the rock-surface in the direction of nearly east and west. This fact still further convinces me of the opinion that some of the beds in that neighbourhood are not composed of equally destructible materials, so as to withstand the wear of time in a uniform degree. The markings on the top of the sea-cliffs, to my mind, are referable to atmospheric and æolian agencies, whilst those of the watercourse have been caused by the combined action of the atmosphere and the little streamlet.

Post-Miocene Climate in South Australia

(Being in part a rejoinder to Mr. Scoular's Paper).

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read August 4, 1885.]

I have never advocated with any earnestness that climatic changes of high value are due to geological rather than cosmical causes; and in a course of public lectures, delivered last year at the University, I applied Dr. Croll's hypothesis to the elucidation of certain physiographic peculiarities of Central Australia, which are co-ordinate with the glacial signs in the southern part of the province. I have had long in preparation a paper on "Climate past and present in its relation to the distribution of animal and vegetable life in Australia," an outline of which formed the basis of the lectures above referred to; but the wish to know by actual observation the physical features of the basin of Lake Eyre has stayed my pen. It is, therefore, with much reluctance that I am forced into this controversy before I am prepared to encompass the questions involved in all their manifold bearings.

Ice-marks.—These and other signs of moving ice are now known in South Australia, at altitudes from 50 to about 2,000 feet from sea level. They have been examined by several geologists well versed in reading such signs in Canada, Great Britain, and Central Europe, who have without exception unhesitatingly attributed them to the action of ice. In Victoria similar phenomena have been observed by Griffiths and Stirling. In the face of the facts, thus daily accumulating, they must be daring men to dispute that *Southern Australia has had a climate sufficiently cold to originate glaciers at comparatively low elevations.* The strenuous opponents to such generalization are Professor Hutton, of New Zealand; Dr. Lendenfeld, of Sydney; and Mr. Scoular, our corresponding member.

Prof. Hutton inclines to the opinion that the glacial period in Australia could not have been so severe as is demanded by the altitudinal and geographic range of the ice-marks observed in South Australia and Victoria, else the simultaneous glacial period in New Zealand would have been of polar severity, which he thinks it was not because of the great abundance of animal life at that time. He writes*—"Neither are there any signs of a Pleistocene glaciation of New Zealand greater than at present."

* Quart. Journ. Geol. Soc., vol. xli., p. 213, 1885.

Prof. Hutton does not make it clear to my comprehension that the Pleistocene deposits so rich in bird remains were coeval with the glaciation of the southern hemisphere. One circumstance which seems to very much invalidate Prof. Hutton's arguments is that New Zealand has been the scene of great oscillation of level during Tertiary times; "the Oligocene and Miocene systems attain an elevation of 4,000 feet in the North Island;" "the marine beds of the Pliocene system attain an elevation of more than 2,000 feet near Napier;" and in the Pleistocene period "I believe that the sea stood much higher than 800 feet in Canterbury," *op. cit.*

[*P.S.*—August 15. More recently Prof. Hutton has modified his opinion, as I gather from the following abstract of a paper read before the Lin. Soc. N.S.W., July 29, 1885:—"The author discusses the phenomena which have been adduced as evidence for the former existence of a glacial epoch in Australia, and shows that they are susceptible of a different interpretation. He distinguishes between a glacier epoch, such as has occurred in New Zealand, in which, owing to various local, but only local, causes, icefields prevailed over much larger districts than at present, and a glacial epoch, such as has been demonstrated in the northern hemisphere, which is the result, not of variations caused and limited by local circumstances, but of alterations universal or cosmical in character. The glacier epoch in New Zealand is regarded as anterior to the glacial epoch of the north."]

Dr. Lendenfeld* characterises my observations† as very vague, and Mr. Griffith's‡ evidence as of a still more vague character. Did I not know that Dr. Lendenfeld has had a large practical alpine experience, I should have been disposed to regard his statements as indicative of incompetency to appreciate at their proper value glacier signs irrespective of their position. It seems to me that his main objection to the acceptance of the observations of myself and others is that we began at the wrong end. He writes:—"Glacial traces must be looked for in the mountains first," and then when found "the investigation can be extended down to the low lands to ascertain how far the glaciers reached." Indeed, I cannot refrain from remarking upon the obvious under current of self-laudation running through his paper—as it were to say, I will ignore all these evidences as I wish to have credit for the discovery of glacial remains; of course up the mountains I will go. And he found them on the high plateau of Mount Kosciusco, but not below 5,800 feet, and concludes that "at the time of the

* Proc. Linn. Soc. N.S.W., vol. X., p. 2.
† Trans. Roy. Soc. S. Aust., vol. II., page lxv., 1879.
‡ Trans. Roy. Soc. Vict., 1882.

glaciation of the southern hemisphere the climate was then not very cold, so that the glaciers only covered the highest part of the Australian Alps, and it is not likely that glaciers existed anywhere else in Australia at the time." Doubtlessly in a certain sense we should look rather towards the high elevations for glacier signs, as there the glaciers would be the last to disappear; but as the lowland tracts may have longer preserved the scorings, scratchings, and other evidences of the passage of land ice by the protecting superficial coverings laid down over its retreating path, we may hope to be more successful in a search here than at the highest elevations where the process of weathering is so much more energetic and persistent. So far as regards the higher levels of the Mount Lofty Range, ice marks are not at all likely to have been preserved on the friable sandstones which everywhere crown elevations above 1,800 feet.

[*Postscript.*—Dr. Lendenfeld "draws attention to some further evidences of ice action in the Mount Lofty group, near Adelaide, where some glacier-polished rocks, with some very well preserved striæ have been discovered and photographed."—Abstract of Proc. Lin. Soc. N.S. Wales, July 29, 1885. In the absence of particulars I cannot be positive, but there is strong circumstantial evidence that this so-called discovery relates to the ice-worn surface at Black Point, Hallett's Cove, which was photographed by Mr. H. Y. L. Brown, Government Geologist, copies of which were sent by him to Sydney. Following upon the very severe strictures on the observations of self and others in reference to the presence of glacial signs, this admission of Dr. Lendenfeld—the prince of sceptics—must remove all doubts as to their value.]

Mr. Stirling* has recently announced the presence of ice-worn and scratched rocks and other glacial signs at elevations as low as 1,000 feet above sea level in the Omeo district, Victoria.

Mr. Scoular's antagonism is the most serious, because he has examined the glaciated surface at Black Point, which he attributes to the action of blown sand; but I will defer for awhile my criticism on that gentleman's observations and deductions that I may now deal with a phase of the inquiry of fundamental importance, namely:—

THE EXTINCTION OF THE ARID AREA IN AUSTRALIA DURING THE GLACIAL EPOCH.

It seems to me that the authors so strongly opposed to the glaciation of southern Australia take for granted that it never existed, and therefore reject the evidences as vague, or explain

* Roy. Soc. Victoria, July, 1885.

them away by the aid of other agents. Moreover they have proceeded on the assumption that the annual temperature at any one place was affected during cosmical changes in proportion to its distance from the advancing or retrograding wave of glacial cold; that the environments remained the same, and therefore by rule of proportion the increment or decrement of heat was invariable. Thus, then, the main grounds of rejection of the evidences of glaciation may be briefly stated as follows:—That the existence of glaciers is incompatible with the high temperature that must have prevailed over this area during the glacial epoch of the southern hemisphere.

If the east coast of the South Island of New Zealand were known only, with what incredulity would have been received the announcement that the transalpine glaciers reached to within 700 feet of sea-level, or 2,000 feet lower than those on the east slope. Of course we understand the why and the wherefore; but had we formed preconceived notions touching the climatology of the western region, based on eastern experiences, how erroneous would they have proved.

Existing causes tend to maintain a higher mean temperature for southern Australia than is demanded by its latitudinal position, and to these Dr. Lendenfeld appeals as fatal to the existence of glaciers except on the alpine plateaux, even at the period of extreme cold; and Professor Hutton argues much in the same way. But were these causes operating with the same intensity always as now? I think not; and their removal and the reciprocity of actions in consequence thereof may have resulted in the production of a climate which, compared with the present, may have offered as great a contrast as those of the eastern and western slopes of the New Zealand Alps.

To state my case:—If we study the present distribution of temperature and aqueous precipitation on this continent, we shall recognise a central arid area from which all around the rainfall increases—tropical rains to the north and winter rains to the south of it. Here in this almost rainless region originate those desiccating winds, which materially elevate the temperature of the southern shores. Guyot has shown that the existence of a dry belt on either side of the tropics is due to permanent laws governing the motion of aerial currents. The locus of high barometric pressure or descending equatorial air-column has a seasonal motion within certain limits—being dependent on the position of the sun in its annual path; so also will it be affected by changes in the obliquity of the earth's orbit. The area of high pressure, or of aridity, has an annual oscillation, and must have also a cyclical one. This

being so, and given the southern hemisphere its maximum of cold and the high latitudinal position of the sun in the northern hemisphere, it follows that the system of trade winds in the southern hemisphere is shifted further north, and with it those other effects which are correlative, bringing our southern shores into the region of copious summer rains, and Central Australia within that of winter rains. More than this, the dry belt would be shifted so far to the north as to be almost obliterated, or, at least, greatly narrowed by its proximity to oceanic waters.

Under such influences the climate of Southern Australia is changed in a way not hitherto foreseen, and the question, did perennial ice exist on its mountains? is not so difficult to answer. By induction we should have been led to anticipate the discovery of those glacier signs, the interpretation of which has created so much unnecessary controversy.

A glacial period and a pluvial period mean the same to me, being referrible to the same cause—rain or snow—according to latitude or elevation.

I have persistently argued for some years that the rainfall has greatly diminished since the Pliocene period, the evidences of which are more striking in Central Australia than in more southern latitudes because of the present poverty of rain there.

A vastly increased rainfall over what is now the arid region of Australia in former times is demanded by the extinct rivers and lakes and the former existence of large herbivores.

1. The Extinct Rivers.—All the watercourses which originate within the dry belt are characterised by the absence of water. It is only towards their sources that they collect the surface drainage, and then only at distant intervals of time. Many of them are of great width and are traceable for more than 100 miles to the depressed area around Lake Eyre, where they become obliterated many miles from the present shore. The Paroo and other of the north-western tributaries of the Darling no longer carry water in their lower sections. The volume of discharge from the River Murray must have been many times greater than now. (See my paper on the River Murray, p. 30, et. seq., vol. VII. of these Transactions).

2. Extinct Lakes.—Lake Eyre is the centre of the continental drainage, and is maintained at the present time by the flood-waters of the Cooper and Diamantina, which are supplied by tropical rains. But toward this extensive depression there are directed many dry river-beds, whilst hundreds of square miles around the present lake margin are covered with sandhills, separated by loamy interspaces, which are littoral sandbanks marking the successive stages in the contraction of the water-

expanse. The basin of Lake Torrens exhibits the same peculiarities as that of Lake Eyre; the margin of the former lake is 111 feet above, whilst that of the other is 39 feet below sea level. The river courses of the Lake Torrens basin are short and rapid, the rainfall is a little more, and not unfrequently the creeks discharge their contents into the lake.

With the features of the Lake Torrens basin I am familiar, and will submit now the chief facts which induce me to the opinion that the present lake is but a remnant of its former self, and that the sandhills are of lacustrine origin.

The plain of Lake Torrens is at its margin chiefly composed of loams and gravels, shed from the adjacent slopes, or transported from the far distant Flinders Range by the torrential streams which debouch upon the plain; other constituents of the gravel are flints and agates quite foreign to the district. Here I picked up a pebble of obsidian. Further out on the plain these drifts are concealed by low, more or less parallel, sandhills separated from one another by loamy flats. The wide trumpet-shaped mouth of the valley of the Aroona River is occupied with breccia and conglomerate to 50 and 80 feet above the level of the present stream course.

The sandhills have a trend conformable with the edges of the main body of the drift, which is by estimate at least 100 feet above the level of the lake-waters. The sandhills are covered with vegetation, and are quite stable. The sand is coarse, sharp, and externally red coloured; angular fragments of white quartz and dark-coloured quartzite up to five millimetres diameter may be gathered at the bases of the sandhills. No fossils have been detected in the sandhills, but the loams have yielded remains of land vertebrates.

3. Extinct Fauna.—That the lake areas of Eyre, Torrens, and Frome were once inhabited by terrestrial and fluviatile animals now totally extinct or repelled is a well established fact; perhaps no other part of Australia has yielded such abundant remains of *Diprotodon* as that about Lake Eyre. Unfortunately the sequence of the beds yielding mammalian and other terrestrial remains is not known; but whether they be isochronous or not—tableland sandstones, the deeper-seated clays and gravels, the more superficial loams, or the sandhills—they all indicate a lacustrine origin. Mr. Debney† obtained fossils from the escarpment of a table-hill, between the Warburton and the Cooper, on the east side of Lake Eyre, in the midst of the sandhill country. They consist of the phalanges and other bones of an emu-like bird, crocodilian scutes and teeth, chelonian plates, and vertebræ of fish. Similar organic

† Trans. Roy. Soc. S. Aust., vol IV., p. 140; 1881.

debris were obtained in a well-sinking near Lake Hurd, north of Billeroo trig, in the basin of Lake Frome; they occurred in a stratum of sharp white sand underlying a clay which is reported to me to have embedded in it stems of "mulga" (*sic*). At Kalamurina Station, near Cowarie, on the Warburton river, about 50 miles north from the first-named locality, and in the same physiographic region, there has been exhumed the fore part of the skull of a crocodile, differing from *C. porosus*, inhabiting tropical Australia, by its shorter, broader, and more massive snout. The specimen graces the Museum at Port Adelaide.

In this connection may be reported the discovery of the lower jaw of *Macropus Titan* and mandibular teeth of *Ceratodus Forsteri* in the bed of a dry lake near Momba Station, about 25 miles north of Wilcannia. The fossils were gathered by Mr. W. Hogarth, and presented by him to Mr. Gavin Scoular, who has obligingly submitted them to me for determination. The former gentleman writes to the latter that the lake is, according to the statement of the Astronomer Royal of Sydney, 350 feet above sea level, and that at times of high floods is filled by the waters of the Darling river, but has not been so until the one of this year since 1864; that after the flood of 1864 cod and other fish were caught in the lake. The highly mineralised condition of the organic remains above referred to is suggestive of their having been washed out of a red loam or earth, and precludes the probability of their recent origin.

As I have elsewhere* pointed out, the existence of the gigantic herbivores in the "dry zone" demands climatic conditions favourable to the growth of a vegetation capable of supporting them, and that their extinction is attributable to those climatic changes which brought about dessication, involving a reduction in volume of the waters of the lakes, and finally converting their basins into saltpans.

I need hardly urge that the replacement of the arid plains by freshwater seas, though a consequence of an amelioration of climate, must have had a reciprocal effect, conversely as the existence of a dry zone produces aridity and thereby intensifies the effect.

Specific Criticisms on Mr. Scoular's Paper.

The Ice-marks at Black Point are on sheared surfaces across the bedding, and their direction is nearly parallel with the trend of the coast. But the consideration of the direction of the marks is of little moment, as we cannot restore the outline of the country at the period of their production for reasons hereafter to be stated.

* Trans. Roy. Soc. S. Aust., vol. II., p. lxvii., 1879; vol. VII., p. 32, 1884.

It is easy to attribute each isolated feature of glacial phenomena to some other cause; but will any other agent than glacier ice satisfy all of them, taken collectively?—the shearing of rocks, furrowed, scratched, and polished surfaces, and morainic debris.

Mr. Scoular has unwittingly succeeded in contradicting himself by attempting to prove too much. When having satisfied himself that the glaciated surface at Black Point is the result of the attrition of blown sand he appeals to similar markings "showing evident signs of having been affected by atmospheric and aqueous agency—the combined action of the atmosphere and the periodic waterflow."

Elevation of sea level and origin of Pliocene Drifts.—The application of Croll's hypothesis demands, according to the opinion of Mr. Scoular, the elevation of the sea level around our shores to 800 or 1,000 feet. This may be true, but if the land has not moved since then our drift-beds should be marine; yet, Mr. Scoular has failed to prove them to be so, whilst the palæontological evidences strongly favour the view of their subærial origin.*

I am unacquainted with marine Pliocene beds in South Australia, or even in Australia. We have nothing equivalent to the Wanganni system of New Zealand, therefore the marine equivalents to the Pliocene Drifts, if extant, are submarine. If, therefore, an elevation of the sea level to a height of about 1,000 feet took place during our glacial period, and as no cotemporaneous marine debris occurs, it is a necessary deduction that the land stood so much higher then than now, to escape the submergence.

Again, if the low level plains are of marine origin, why not the upland plains, which present the same characteristics? In the case of the Willochra plain, an elevation of sea level to a height of 1,500 feet is required for its marine origin; in the case of the Terowie plain, rather more; and in that of Yarcowie, close upon 2,000 feet. Here Mr. Scoular is very inconsistent, for, while inadvertently admitting the lacustrine origin of the high plains, he will not apply to them the same arguments which lead him to attribute a marine origin to the low-land plains. Surely if the vast area—more than three-fourths of the whole settled parts of South Australia—had been buried beneath the sea some vestiges of its marine fauna would have been forthcoming.

Further, a greater elevation of the land is demanded by the extension of the drift deposits below sea level. In the Adelaide bore the drift beds have a thickness of 69 feet, their base

---

* Trans. Roy. Soc. S. Aust., vol. II., pp. lxii., et. seq.

being, however, 70 feet above sea level; but on the western side of the Older Tertiary escarpment at Adelaide the drift beds are at deeper levels and are projected below low-water mark in Holdfast Bay. In the Port Wakefield bore these beds were bottomed at 312 feet below sea level, and throughout their thickness are highly charged with carbonaceous muds. In the Stirling bore, near Port Augusta, the base was not reached at 460 feet, corresponding to a depth of 356 feet below low-water mark. Here, also, carbonaceous muds were passed through, and a few fragments of crocodilian scutes were obtained.

It has not been definitely proved that the deposition of the Pliocene Drifts was contemporaneous with the existence of our glaciers, but their mode of occurrence, nature, and organic remains imply great aqueous precipitation during the period of their accumulation, and therefore presumably coeval with the glacial phenomena. The view of the lacustrine origin of the drifts of the lowland and upland plains may seem at first difficult of acceptance, because of the necessity for barriers across their lower ends to impound the drainage. Actual barriers are recognisable in a few cases, as that formed by the Older Tertiary escarpment at Adelaide, through a gap in which the River Torrens now flows; a similar feature is seen in the valleys of the Light and Gilbert, near Hamley Bridge. In most of the upland plains the flanking hills converge at the lower end, leading one to suppose that at deeper levels they increasingly approach one another to form a gorge; but in most cases the great depths to which the old valleys have been filled precludes all hope of ever learning much on this point. As to the great lake region of Central Australia, the configuration of the present surface permits of a vast increase in the area and depth of the water in each basin. In the case of the Adelaide Plain, its lacustrine origin demands a barrier across what is now St. Vincent Gulf; but the truncated margin of the drift around its shores and the depth below sea level to which the drift extends at Port Wakefield, indicate that the gulf has been excavated out of the drift beds. From this and other circumstances it is not possible to restore the configuration of the land surface immediately prior to the glacial period, and therefore the pre-existence of barriers must remain an assumption, as also that the building up of terminal moraines may have been the primary cause of the filling up of deep valleys with subaerial detritus. Mr. Scoular argues against any Extensive Upheaval of the Land, because "the drainage of the present river system would have been completely altered." But the fact that the River Torrens has cut its way across the inclination of the strata in deep gorges and contrary to the

natural drainage of the country indicates that the formation of its bed took place prior to the development of the present configuration. The valley and gorge of the Lower Onkaparinga is another example of an old river system.

Existence of Gum-trees Incompatible with a Glacial Climate.—Mr. Scoular has referred the drift-wood found in the Pliocene beds to living gum-trees, but on what evidence he does not tell us, though doubtlessly true. But his statement that gum-trees do not grow at high altitudes is erroneous, as there are several subalpine species—*E. amygdalina* ranges to 5,000 feet on the Snowy Mountains, whilst shrubby states of other species locally known as "snow gums" ascend to the edge of the highest plateaux at 6,000 feet.

Marine Origin of the Upland Miocene.—Mr. Scoular does not adduce any proof of the marine origin of the gold-bearing drifts and coterminous deposits which range up to altitudes of 1,000 feet or thereabouts, and ignores the evidences furnished by their mechanical condition and the embedded vegetable debris. His facts touching the molluscan life of the youngest member of the marine Miocene deposits are very incomplete, and his deductions therefrom are very fallacious. It is true that oysters dominate the beds, but they had for associates several species of Pecten, some closely allied to the recent species *P. australis*, *P. bifrons*, and *P. pleuronectes;* the living *Placunanomia Ione*, and *Lucina dentata*, *Trigonia acuticosta*, a *Meleagrina* very near to *M. margaritifera*, *Cucullæa Corioensis*, a large *Donax*, and several other bivalves. Among gastropods *Cassis textilis* and *Haliotis nævosoides* are conspicuous; in other classes *Clypeaster Gippslandicus* (McCoy) and *Balanophyllia* sp. are noteworthy. If we may predicate climate from such an assemblage, it would not be in the direction of a colder climate than which now prevails over the same area. The apparent paucity of species in the oyster beds is probably due to destruction of their shells by the solvent waters freely admitted by these incoherent and superficial beds, as the majority of the fossils are those with calcitic tests.

Summary.

1. That the evidences of the glacier period in South Australia are numerous and pronounced, and reach as low as present sea level.

2. That the glacial phenomena were not local, but are attributable to those cosmic causes which produced glaciation at a more recent period in the northern hemisphere.

3. That the extension of the subaerial deposits of the glacial period below sea level demands elevation of the land at the period of their accumulation corresponding in amount at the

least with that of their present submergence. (Four hundred feet actually known.)

4. It is highly probable that upheaval was an important factor of climatic change at this period. The relationships of the Post-Miocene faunas and floras of the continent with those of the large adjacent insular masses demand a more intimate connection with the continental area than that which now obtains; this was probably furnished by elevation of the sea bed.

5. That the present arid zone of Central Australia was, during the glacial period, a region of copious rainfall, of fresh-water seas, and perennial rivers; now a barrier to the commingling of the south-western and eastern floras and faunas; it, at that time, was doubtlessly the line of migration of the eastern species of south-western generic types, and *vice versa*.

Remarks on the Nomenclature of some of the South Australian Butterflies, with Observations.

By E Guest.

[Read September 8, 1885.]

Having given much of my leisure time during the last six years to the study of such of the Lepidopterous fauna as are to be found in the neighbourhood of Balhannah, I wish to place some of the results of my observations before the Society.

It is quite a mistake to suppose that butterflies and moths are scarce in South Australia; in places they may be, and the Rhopaloceræ are certainly not abundant in species, but all other families are extensively represented, and only want looking for. As a proof of this I may mention that I have taken nearly 500 species within a radius of three miles of my house, and am continually finding fresh ones. A very fair percentage of these have turned out to be new to science, of course chiefly among the micros, although out of 45 species of Geometrina nine were returned as "not previously described." This makes it very evident that to get anything like a fair knowledge of our fauna we must have more workers, and knowing by experience the disheartening nature of the pursuit, through the difficulty of obtaining correct specific determinations, I thought that I would make an effort to get the nomenclature cleared up, so far as my limited knowledge and opportunities would allow me.

For this purpose I have remitted specimens of all the doubtful species of butterflies that I possessed to Mr. E. Meyrick, B.A., &c., of Sydney, whose kindness and courtesy I cannot speak too highly of, asking him at the same time to identify all that he could of such species as are mentioned in Mr. Tepper's papers, but of which I did not possess specimens. The results of our correspondence I now epitomise in the following list, which I believe is correct so far as it goes, but unfortunately the species of Hesperidæ and Synemonidæ are difficult of identification without specimens, and many of Mr. Tepper's are consequently omitted.

As will be seen, our new species have been ruthlessly cut down—in fact, I very much doubt if there be a single butter-

fly in either list that has not been previously described, and even the number of species given is much understated. The present endeavour may, however, be of assistance to any beginner intending to pursue this subject as a prelude to the more interesting, though more difficult, study of the other families :—

Pieris aganippe (*Don*).—Occasionally seen, but not common, at Balhannah. April and after hybernation, in September.

Pieris harpalyce (*Don*).—The figure of this species represented in Mr. Tepper's paper (p. 3., fig. IV.) is not harpalyce at all, but the male of P. aganippe. The true harpalyce may be at once recognised by the large red spots on the underside which are wanting in the aganippe.

Terias smilax (*Don*).—Common at Balhannah some years, absent in others. October.

Pyrameis itea (*Fabr.*).—Pretty common. March and in the spring, after hybernation.

Pyrameis cardui (*L.*).—Very common.

Junonia velleda (*Fabr.*).—Very common.

Xenica Klugii (*Guerin*).—Very common, but only single-brooded in the hills. October and November.

Xenica achanta (*Don*) ; Las ocrea (*Guest*).—Local, but generally abundant where it occurs. Scarce at Balhannah. November and December.

Heteronympha merope (*Fabr*).—One of our commonest insects out in November. The male soon disappears, but the female keeps about all the summer, but is never, I think, seen the following Spring.

Danais chrysippus.—A rare insect here. March, and hybernates.

Danais erippus (*Cram.*).—I have never taken this insect at Balhannah, but it is very common at Norwood.

Ialmenus ?, spec.—I take one fine species of this genus up here some years not uncommonly, but as yet have not succeeded in getting it identified (perhaps I. icilius). Mr. Tepper's Cupido œneus is also of this genus, but of which species is uncertain.

Lycæna discifer (*Herr Schäff*).—A common insect both here and most places. It frequents open grassy paddocks in this neighbourhood. November.

Lycæna Bœtica (*Lin.*).—Not very common most years ; flies very fast. September and October, and again some years at the end of April.

Lycæna agricola (*Hew*).—Generally common, but not often met with here.

Lycæna erinus (*Fabr.*).—This is Mr. Tepper's Cupido simplexa. t occ urs here, but not very commonly, frequenting thick

bushy paddocks in November. The Balhannah specimens appear rather smaller than Mr. Tepper's specimen.

Lycæna alsulus (*Herr Schäff*).—This is Tepper's Cupido delicata, and my L. purvulgatus. Common all the year round. Varies greatly in size.

Lycæna biocellata (*Field*).—Is Tepper's Cupido adamapuncta. A common insect here, and widely distributed, extending to Fiji. November, &c.

Lycæna serpentata (*Herr Schäff*).—This is Cupido fasciola of Tepper, and C. molybdena of my list. It appears to be nowhere very common, but distributed all over the colony, Mr. Meyrick having taken it at Quorn. Out in October, and may be occasionally found all through the summer in grassy places.

Lycæna Heathii (*Cox*).—This is the L. paradoxa of my list; it is not included in Mr. Tepper's. During the last two years I have taken it rather plentifully, and it appears to be widely distributed. Out in October, and I think must be double-brooded as I also take it quite fresh in March.

Ogyris otanes (*Field*).—This is not taken here; but I have included it on Mr. Tepper's authority, as there can hardly be any mistake in such an insect as this.

Trapezites petalia (*Hew*).—This is Hesperilla quadrimaculata of Mr. Tepper. I have not as yet seen it here, but it appears fairly distributed.

Taractrocera papyria (*Boisd*).—This is my Hesperilla fumosa; it does not appear to be included in Tepper's list. Is locally common here, and is widely distributed.

Synemon sophia (*White*).—Is Mr. Tepper's S. læta. It is common here, and is taken all over the colony, but appears to be peculiarly South Australian. The true S. læta is quite a differently marked insect.

Synemon theresa (*Dark var.*).—Is Mr. Tepper's S. obscura. I take it here, but not commonly.

Descriptions of and Notes upon the Species of the Genera Murex and Typhis, known and recorded to Exist on the Coast of the Colony of South Australia.

By W. T. Bednall.

[Read September 8, 1885.]

In presenting this paper to the Royal Society of South Australia I am actuated by the wish to place such information as I have obtained on the subject at their disposal, and also that through this channel the same may be communicated to authors, students, and collectors elsewhere. Mr. G. W. Tryon's "Manual of Conchology," a recent and most valuable work, comprehending all the known species up to the date of publication, has afforded me considerable assistance in checking our own species, but at the same time it has shown me that conchological authors and collectors are still very much at a loss for authentic information as to the habitats and local distribution of many shells; indeed, notwithstanding the zeal with which in these days of scientific travelling and exploration every corner of the globe is ransacked for new treasures, the number of species still with "habitats unknown" attached to them is remarkable. As Conservator of one of the most magnificent collections in the world — that of Philadelphia — Mr. Tryon, has facilities for comparison and reference that cannot possibly be enjoyed by students in distant countries; and the same may be said of the curators of the splendid museums of England and the Continent. But in their limited sphere local collectors have opportunities of doing service to science by distributing specimens and recording personal observations, by which means the many difficulties of identification which so sorely trouble the naturalist will gradually be lessened, and authors will be saved the unpleasantness of again and again giving new names to the same shell. As an instance in point, one of the species included in this paper is fettered with no less than four different names, besides a probable fifth.

We have five recorded species of Murex, four of which are known to local collectors.

Genus Murex, Linnæus.

M. (Pteronotus) triformis.—Reeve, *Conchologia Iconica*, pl. 13, f. 53.—Shell angularly elongate and absolutely triangular

in looking at it with the spire in the foreground; spire two-fifths the length of the body whorl; whorls six, angulated towards the upper part and slightly nodulous between the varices, transversely striated, the grooves increasing in width and ending in a delicate frill on the varices of the body whorl; varices with a single open projection or spine posteriorly both on the spine and body whorls in a line with the nodosities; aperture ovate, but sinuating considerably posteriorly near the outer lip; canal somewhat long, not quite closed, and in most specimens increasingly open towards the anterior end, which is strongly recurved; outer lip finely crenate; inner lip smooth, spreading over the columella; colour fulvous brown, in most specimens increasing to deep purple, while others again are of a creamy white; inside white; length 3 inches, breadth 1.3 inch.

Distributed generally throughout South Australia. Dredged at a depth of from two to ten fathoms in St. Vincent's Gulf.

King George's Sound, Western Australia.

Tasmania, where, however, the specimens are much smaller.

A very pretty shell when in good condition. The varices form an elegant frill nearly the whole length of the shell, which is especially conspicuous on the margin of the outer lip, and, in perfect specimens, the recurved canal becomes a strong hook.

M. (Pteronotus) Angasi.—Crosse (*Typhis*) *Journal de Conchyliologie*, 1863, pl. 1, f. 2, *M. eos*, Hutton, *Manual of New Zealand Mollusca*, 1873.—This small species has the general appearance of young examples of the preceding one, but the varices at their juncture with the suture are very canaliculate and much hooked backwards. In the spaces between the varices are two or three small rounded close canals of varices, giving the shell the appearance of a Typhis, in which genus it was placed by M. Crosse. Last whorl larger than the spire; aperture small, nearly oval; columella arcuated; outer lip large and foliaceous; canal slightly oblique and recurved backwards; length 6, breadth 3 lines.

St. Vincent's Gulf (Tate); Port Lincoln (Bednall).

Tasmania (Atkinson).

Port Jackson, N.S.W. (Angas).

New Zealand (Hutton).

M. (Phyllonotus) octogonus.—Quoy and Gaimard, *Voyage of the Astrolabe*, vol. ii. p. 531, pl. 36, f. 89. *M. scalaris*, A. Adams, *Proceedings of the Zoological Society, London*, 1853, p. 71. *Trophon umbilicatus*, Tenison Woods, *Pro. Royal Soc. Tas.*, 1875. (?) *M. Brazieri*, Angas, *Pro. Zool. Soc.*, 1877, p. 171, pl. 26, f. 3. Shell elongately oval, solid, spire pointed, about half the length of the shell, and a trifle longer than the aper-

ture; whorls 5-6, spirally grooved, rounded, angular at the upper part and slightly concave at the suture; strongly variced longitudinally, the liræ made by the spiral grooves ending in open foliations on the varices of the body whorl, which are eight in number, and terminating in the vicinity of the umbilicus in coarse raised laminæ; outer lip finely notched on the margin and crenate internally; inner lip smooth, spreading over the columella; light fulvous brown, ribs deeper in colour, pinkish inside; length 12, breadth 6 lines.

St. Vincent's Gulf (Tate, Bednall). Kangaroo Island (Tate). "Dredged along with horny zoophytes and nullipores at a depth of seven or eight fathoms" (Angas).

Tasmania (Tenison Woods).

Moreton Bay, Queensland (Strange).

Following Mr. G. F. Angas in his paper on the Marine Molluscan Fauna of South Australia, contributed to the Zoological Society in 1865, I had named my specimens of this shell and catalogued it in this paper as *M. scalaris* of Adams, but Professor Tate has not only kindly shown me the original description and figure of Quoy and Gaimard in that magnificent work the Voyage of the Astrolabe, but a very perfect and beautiful specimen obtained by him at Kangaroo Island; also a very large fossil example from the Tertiary formation of New Zealand. From the comparisons made I feel sure that there can be no doubt of the identification of the South Australian shell with *M. octogonus*. In New Zealand the species attains twice the size it does in these waters, and in the type specimen figured by Quoy the foliations on the varices are much more prominent. Mr. Tryon reproduces Quoy's figures in his Manual of Conchology, vol. ii., pl. 30, figs. 272 and 273. He also gives a representation of *M. cuspidatus*, Sow. (fig. 24), which he says is a synonym. This more nearly represents our form than the original. By rejecting the synonyms of Adams and Woods it will be seen that the shell under review is recorded from South Australia, Tasmania, New Zealand, and Queensland, but not from New South Wales; the description and figure of the *M. Brazieri* of Angas, noted above, from that part of the Australian coast, answer so closely to *M. octogonus* that there is little room to doubt that it is that species described from an immature shell.

In the Manual of Conchology before referred to Mr. Tryon has expunged the M. *scalaris* of Adams, and substituted for it the name of *M. Angasi*, adding the following remarks;—"Said to resemble *M. cristatus*, Brocchi. Possibly identical with *M. octogonus* (Quoy et Gaim). As Brocchi has used the name for a fossil species, this may be known as *M. Angasi*." There was little occasion for Mr. Tryon to rename *M. scalaris*, as

apparently he himself had small doubt of the shell being referable to *M. octogonus*; besides his work contains (only a few pages previously) the description of the *Murex Angasi* of Crosse.

M (Ocinebra) pumilus.—A. Ad.; *Pro. Zool. Soc., Lond.*, 1863, p. 70.—Shell small, fusiform, imperforate, with distinct rounded (about eight) varices extending the whole length of the shell crossed by fine transverse liræ ending abruptly on the outer lip; whorls four to five rounded; aperture oval, attenuated anteriorly, inner lip smooth; outer lip waved in answer to the exterior liræ; colour grey, but worn specimens are a delicate flesh colour both outside and in; length, 4½; breadth, 3 lines.

MacDonnell Bay, Fowler's Bay (Tate). Henley Beach, Semaphore, Aldinga (Tate, Bednall). East side St. Vincent's Gulf (Angas). Also received by me from Port Lincoln.

In some specimens the transverse liræ are more prominent than the varices, giving the shell at a superficial glance the appearance of a different species.

Both the *M. pumilus* of Kuster and *M. pumilus* of A. Adams are figured in Tryon's work, the former in pl. 36, f. 413 and the latter in pl. 38, f. 470, but neither of the figures really represents the shell which I have here described.

M. serotinus—A. Ad.; *Pro. Zool. Soc., Lond.*, 1851, p. 268.

One specimen obtained (alive) amongst the rocks at low water spring tides, Aldinga Bay (Angas). Not known to local collectors.

Mr. Tryon has been unable, from the meagreness of the original description and the absence of any figure of the shell, to place this species in any of the sub-generic groups; and in his Manual of Conchology he has included it in a list of indeterminate species. Mr. Sowerby, the same work states, affirms that the shell is synonymous with *M. Blainvillei*, Payr., a Mediterranean form.

Genus Typhis, Montfort.

Typhis Yatesi.—Crosse, *Journ. de Conch.*, vol. xiii., p. 54, pl. 2, f. 3.—"Shell imperforate, subquadrangular, elongately oval, somewhat thin, translucid, white in colour, slightly tinged with pink; whorls six, each one bearing four flexuous compressed jagged varices, terminating in a hollow sharp and recurved spine when perfect, in the spaces between the varices a prominent simple tube; canal entirely closed from the aperture to the base, somewhat large, slightly oblique and recurved. Length fourteen millimetres, greatest diameter seven. This species is easily distinguished from its congeners by the elegant denticulation of the varices."—*Crosse.*

Holdfast Bay, Semaphore, St. Vincent's Gulf (Angas, Tate, Forwood, Bednall). Stansbury (Tate). Somewhat rare.

A Few Remarks About Weather Forecasting for South Australia.

By W. Ernest Cooke, B.A., Acting Government Astronomer.

[Read Sept. 8th, 1885.]

The comparatively recent science of meteorology has advanced sufficiently far to become of considerable practical benefit to mariners, farmers, and all those whom the question whence the storm cometh and whither it goeth vitally affects. Having recognised the great strides that have lately been made, a number of persons seem to think that now it is a comparatively easy matter to forecast coming weather for one or two days ahead with absolute certainty; and, in fact, several letters and articles have appeared recently in various colonial papers taking up this view of the case, and causing many to wonder why, under the circumstances, reliable weather forecasts are not issued in the daily papers. I wish, in these remarks, to place before the Society a few considerations as to the reasons why such a desirable result cannot at present be brought about, as far as South Australian weather is concerned.

The manner in which a number of the aforementioned articles refer to this matter indicates a misconception. They liken the approach of a cyclone from the westward to the advent of a railway train whose times of passing the successive stations are duly telegraphed. It passes Albany at a given time, Esperance Bay some hours later, and Eucla a certain number of hours later still. Now we have only to make a very simple calculation in order to find out the exact time it will pass, say Adelaide. The only meteorological reports that are necessary are those from, say, Albany, Esperance Bay, and Eucla, and all within reach of a daily newspaper ought to be informed with absolute certainty of the state of the weather two or three days ahead. Yet this is not done. Why? Possibly there are one or two premises, stated or inferred, in the above argument that are to a certain extent unsound. First of all, we say a depression passes Albany at a certain time. Who is to tell that? I suppose Albany is one of the most impossible places in the world to state with any certainty that a depression has passed eastwards. The winds there seem to be almost always westerly, so they can be no guide to the direction of the central depression; and the barometer is so differently affected there from other places along the coast that

it by itself offers no sure guide. Very often Albany will report a sudden fall of half an inch in twenty-four hours, while other places will be entirely ignored by the depression. Then again suppose we are satisfied, from a concurrence of reasons, that a storm centre lies to the south of Albany, we have no guide whatever as to what its movements will be. By mapping out the whole of Australia and New Zealand with isobaric lines, as is regularly done every morning, we can perhaps infer to a certain extent that certain particular movements are unlikely. If, for instance, an anticyclonic area, or a region of high barometers, were lying over south-eastern Australia, and another over, or to the west of New Zealand, the normal winter high pressure being over central Australia, while a low pressure was noticed to the south or south-east of the Leeuwin, we would have fairly good reasons to suppose that the said low pressure would not move eastwards for a time, until some changes had taken place in the conditions over south-eastern Australia and New Zealand. But when no such decided barriers are opposed to a storm's progress, it is not always easy to say in what manner one that is supposed to be off the Leeuwin will act. Sometimes it will come steadily eastward, sometimes south-east, sometimes shoot up into the Great Bight, and after an indefinite time travel south-east, sometimes southward, sometimes remain where it is, and sometimes all trace of it will disappear during the course of a day.

The most serious difficulty with which we have to contend lies in the fact that almost all the storm centres keep well to the south of the continent. We have thus very often no sure guide as to the distance of this centre, no exact knowledge of the shape of the isobars, even on the northern quadrants, none whatever on the southern, and no idea of the state of the atmospheric pressure to the south-east, south, and south-west, to give reasonable grounds for assuming the centre will move in any given direction, or with any given velocity. When we have managed to satisfy ourselves that a disturbance lies a little south of Eucla, as a general rule we notice that the time of lowest pressure will occur at Adelaide about 20 to 24 hours later. but sometimes the minimum readings occur almost simultaneously at the two stations. There is, however, a very large percentage of storms that once fairly seen to be on their way past Eucla will reach Adelaide in from 12 to 24 hours.

Another difficulty occurs. Suppose we have noticed a storm centre pass Eucla, after having previously traced it past Albany and Esperance Bay, and have noticed that it is a perfectly steady and business-like storm, proceeding onward composedly and regularly in its work of destruction or otherwise, and we can be pretty certain that Adelaide will have a

minimum barometric pressure within the next 24 hours, and Cape Northumberland some six or twelve hours after. Even in such a case as this, it is not always positively certain that a given kind of weather will follow. There are, of course, certain rules as to the kind of weather we may expect at different parts of a storm's path. These are purely empirical, and have been collated from observations made on Australian storms since the establishment of the Western Australian telegraph. Any rules that have been previously discovered in the northern hemisphere have been found to be of no practical use for application here. We find that we must carefully investigate as far as possible our own storms, and find out empirical laws therefrom for our practical guidance. As a matter of fact, one rule seems to be pretty firmly established—that with a certain class of depressions, occurring mostly in winter, the weather is fine a long distance ahead of the coming storm; as the centre approaches the sky becomes clouded over first with cirrus, then cumulus, or rather cumulo-stratus. Light rain sets in some time before the lowest pressure, and while the wind is still light from the north; but after the lowest pressure has passed the wind veers to the S.W., the clouds change into scattered watery cumulus, nimbus, and scud; the wind blows strongly, and the rain descends in heavy showers. I think I may say that this is the usual type of winter depressions; at all events, most of those during the late winter have been of this sort. But, then, the light rain preceding the centre sometimes starts two days, sometimes only a few hours, prior to the passage of minimum pressure. Sometimes the light rain is absent, and we experience a strong northerly gale. Sometimes the weather clears almost directly after the passage of the centre, and sometimes remains showery for a week. We might think it would be very easy to tell what particular sort of weather was connected with any particular part of the movement by noting the change at the various western stations as the storm centre passed them. But suppose Albany reports fine weather almost up to the time of minimum pressure, followed by very heavy rain, Esperance Bay heavy rain followed by scattered showers, and Eucla a strong northerly gale with no rain and a veer to west or south-west with fine weather after the passage, while Streaky Bay and Port Lincoln report threatening weather, it is rather difficult to say with any degree of certainty which of these different phases will be presented as the disturbance passes Adelaide. We are never at all sure of a depression until Eucla shows indubitable signs of its presence; but when once it has passed Eucla it is almost certain to travel eastward or south-eastward, and thus for a large number of storms we have warning at least twelve hours in advance.

I think it would be premature to issue forecasts at present until we get to more thoroughly understand the behaviour of storms between Leeuwin and Eucla, and the only way to do this is by careful inspection every day of isobar maps of the entire continent, such as are displayed in the hall of the Post-office, and by carefully noting the weather accompanying certain recognised forms of disturbance. Melbourne is much more favourably situated than we for forecasting, since, as I I have pointed out, storms are to a great extent regular in their passage after passing Eucla, and thus observers at Melbourne have very often a good thirty-six hours' warning at least. Of course a number of circumstances may easily tend to render a forecast at Melbourne incorrect—such, for instance, as the case of a storm-centre off the south of Tasmania moving up or expanding northwards. This has happened on several occasions, and of course no warning of this could possibly be obtained. The cause of such a movement would probably be found far away in the Southern Ocean.

As a matter of fact, forecasts are published regularly in the *Argus* by the Victorian Government Astronomer, and, I believe, are to a very great extent trustworthy. With our present knowledge of the general laws of storms, and the behaviour of certain particular types of Australian cyclones, I believe it would be possible to issue forecasts for twenty-four hours ahead, of which a large percentage would be correct. Owing to the difficulties I have pointed out, however, the forecasts could not be absolutely depended on; but we may look forward confidently to some time in the near future when fresh discoveries and more elaborate research will enable the practical meteorologist to foretell with comparative certainty the coming climatic conditions for one, two, or three days, if not for weeks.

Additions to the Flora of Extra-Tropical South Australia, including Descriptions of Two New Species.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

Dysphania simulans, *F. von. Mueller* and *Tate*.

Erect, stemless or very short stems or branches from the root, densely beset with short glandular hairs; leaves conspicuously stalked, ovate-oblong, cuneate at the base, wavy at the margin or bluntly short-lobed; flowers in elongated leafless, dense, simple spikes; segments of the calyx three, somewhat scarious, inflated, prominently angular in front and at the margin, pointed at the summit, closing valvularly together over the fruit, the lateral angles membranous, not fringed; tube of the calyx semiovate, papillular; stigmas two, subtle-capillary; fruit spherical, pale-brown, smooth, translucent; embryo nearly semicircular.

Gypsum, salt-flats, Cootanoorinna, on the west side of Lake Eyre; *Malcolm Murray*.

This plant simulates in a remarkable manner the *D. plantaginella*, *F. v. M.*, so much so, that without careful inspection it might be passed for that species; but the leaves are provided with slender stalks and sinuated margins, the flowers are larger and not so readily falling off in age, the bracts less developed, the segments of the calyx are almost deltoid, not obovate, not thinly attenuated, but connate into an almost hemispheric base, which partly encloses the fruit; the latter is broader, not ovate, the raphe forming a broad dark-brown band. Some approach of the genus *Dysphania* to the section *Orthosporum* of *Chenopodium* is established by this species, as will be noticed by a close comparison of *C. atriplicinum* and particularly *C. cristatum*.

Trianthema turgidifolia, *F. v. M.*; Frag. X., p. 83, 1876. Interior. *F. v. M.*, in 2nd Supplt. Census Aust. Plants.

Crotalaria Mitchelli, *Bentham*. Strzelecki Creek. *James Macleod!*

Loranthus gibberulus, *Tate*.

Branches and foliage hoary-tomentose; inflorescence woolly-tomentose. Leaves alternate or nearly opposite, terete, stout, erect, mostly two inches long. Flowers axillary, pedicellate,

in pairs, or the common peduncle bearing two rays, each with two pedicellate flowers. No bracts. Calyx border deeply cup-shaped, truncate; bracteole gibbous adnate to the calyx tube. Petals four free, narrow, woolly externally, glabrous and dark red interiorly, one to one and a half inch long, dilated apex of bud tetragonal. Anthers adnate, oblong linear. Style filiform, nearly as long as the corolla. Fruit not seen.

Parasitic on *Grevillea nematophylla*, which is restricted to the "gypsum rises" of the William Tableland, Lake Eyre basin, west. *Malcolm Murray*. Flowering in April.

This new species has a general agreement with *L. linophyllus*, and especially with *forma c.* (*Bentham*), having woolly-tomentose flowers, but it differs by its cup-shaped calyx border, stouter habit, tomentose investiture, and by the gibbous base of the calyx-tube. It resembles *L. Quandang* by its investiture, but the leaves, calyx, and pedicellate flowers are different.

STYPHELIA (LEUCOPOGON) COSTATA, *F. v. M.*, in Southern Science Record, April, 1885. *S. striata, Tate*, Trans. Roy. Soc., South Australia, vol. VI., p. 166 (*non., Sprengel*). Kangaroo Island.

STYPHELIA (LEUCOPOGON) STRIATA, *Sprengel*. Eucla (*teste, F. v. M.*)

XANTHORRHÆA TATEANA, *F. v. M.* *X. quadrangulata, Tate*, Trans. Roy. Soc. South Aust., vol. VI., p. 168 (*non., F. v. M.*). Kangaroo Island. Probably Mount Crawford Swamps, near Williamstown; and the Black Swamp, District of Encounter Bay.

I. On the Persistency of Electric Currents in Masses of Iron.

II. The Cause of the Luminosity of Flame.

By Prof. H. Lamb, M.A.

The following abstracts form the substance of some remarks, accompanied by experiments, delivered by Prof. Lamb before the Society on the evening of March 3, 1885, *with supplementary remarks by Prof. Rennie :—*

On the Persistency of Electric Currents in Masses of Iron.

Professor Lamb showed some experiments illustrating the gradual decay of electric currents circulating in a cylindrical bar of iron, and subject only to their mutual induction. A bar of iron two inches in diameter was surrounded by two coils of copper wire, which may conveniently be called the primary and the secondary coil. A steady current from a battery is made to circulate round the primary coil, and so magnetise the iron bar. This circuit being suddenly broken, currents are induced in the bar, which tend to maintain its magnetism. The decay of these currents and of the accompanying magnetism produces a gradually diminishing electromotive force of induction in the secondary coil, which is in circuit with a sensitive mirror galvanometer. The intensity of this electro-motive force at any instant after the break of the primary may be estimated by closing the secondary circuit, which is previously open, and observing the first swing of the galvanometer needle. The breaks and makes were made by means of an Attwood's machine, and the interval between the "break" of the primary and the "make" of the secondary could be varied. In the actual experiments this interval was increased by successive steps of ·15 of a second. In this way the gradual decay of the currents in the iron can be traced without difficulty for over $1\frac{1}{2}$ seconds from the time of the original break. According to theory the persistency of the currents is proportional to the square of the diameter of the bar, so that for an iron cylinder a foot in diameter the corresponding interval of time would be about a minute. Some account of the above experiments was given to the Society nearly two years ago, but the experiments have recently been repeated with various improvements in the method of observation, and the author

hoped soon to be able to lay the final results before the Society.

On the Cause of the Luminosity of Flame.

Professor Lamb called attention to a very interesting discussion which had recently taken place on the above subject in Germany. Luminous flames are of two kinds. In the first kind—for example the upper part of the flame of a candle or of an ordinary gas flame—we have an intense white light, caused, as is generally held, by particles of solid carbon shining in virtue of their high temperature, just as an iron bar becomes white hot if its temperature be sufficiently raised. It is fair to mention, however, that this explanation has been called in question, but the balance of evidence seems on the whole decidedly in its favour. The discussion to which Prof. Lamb wished to call attention had reference to the second class of flames, where we have a gas shining with a light (generally faint) of its own, and containing no solid particles. An instance is the flame of a Bunsen's burner well supplied with air. It is generally supposed that this light is simply due to the fact that the gas is at a high temperature; that in the chemical processes of combustion a certain amount of heat is set free, which has the effect of raising the temperature of the gas; and that the luminosity is a secondary effect due to the rise of temperature. This view has been recently called in question by W. Siemens, of Berlin, who finds that air and some other gases may be raised to a temperature considerably above that of the Bunsen flame without becoming in any degree luminous. The observations were made at night on the air, &c., contained in an oven, used in the manufacture of hard glass, the walls of which could be raised to a temperature above that of melting steel. The line of vision passed through two opposite apertures in the walls, and care was taken, by arranging suitable screens, that no light from the walls themselves should reach the eye. Siemens suggests that the light of the Bunsen flame is a direct result of the chemical changes which are going on, and has nothing to do with the temperature of the gas. It is, in fact, conceivable that the violent tearing asunder of the molecules and the rearrangement of their constituents in other combinations may give rise to disturbances in the luminiferous ether. This explanation is supported by the fact that if care be taken to secure a more intimate mixture of the air and other gases before combustion the flame becomes shorter, although much hotter, the chemical processes being completed within a shorter distance from the nozzle. If the light were the result of the temperature, then the flame ought to become longer instead of shorter, for the

gases could move away further from the nozzle before cooling down. The views of Siemens are supported by the observations of E. Wiedemann and of Hittorf on the passage of electricity through rarefied gases. E. Wiedemann has found, by a direct measurement of the heat developed that a gas may become luminous under the influence of an electric discharge whilst its temperature is considerably under the boiling point of water. Hittorf, by means of a powerful bichromate battery of 2,400 cells, obtained an apparently continuous current through a glass tube containing rarefied gas. On some occasions the gas was luminous whilst the tube was not too warm to be touched by the hand without inconvenience. This is, of course, quite inconsistent with a high temperature of the gas. In another experiment the current was led by iridium terminals into a tube, and a dark space was observed round the positive terminal. This terminal became so hot that the metal softened, glowing with an intense white light, whilst the gas immediately in contact with it (and therefore at a very high temperature) was quite dark. We have, then, very strong evidence that gases can become luminous under the influence of electrical processes, independently of a rise of temperature; and considering the very close relations between electrical and chemical actions, it is not surprising that the same should be true of chemical processes, such as we meet with in combustion.

Professor Rennie then made some remarks on the cause of the luminosity of the first class of flames mentioned by Professor Lamb:—The usually accepted theory regarding the luminosity of an ordinary candle or gas flame is that it is due to the presence of solid particles of carbon at a white heat. Some years ago Professor Frankland made some experiments which he thought disproved this theory. He showed that intense light can be produced under conditions which, as he believes, excluded the possible presence of any solid particles —for example, arsenic burning in oxygen. In this case it is said that the temperature of the flame is such that the arsenic itself and the products of its combustion must be in a state of vapour. He showed also that certain non-luminous flames become luminous under increased pressure. He ascribed the luminosity of ordinary flames therefore to the presence of very dense hydrocarbons at a very high temperature. He was confirmed in this belief by the transparency of such flames and by the fact that the soot deposited on cold substances placed in the flames was not pure carbon, but contained hydrogen. Since Frankland's experiments were made other scientists, chiefly in Germany, have investigated the subject, with the result that the original theory has been confirmed for the

following reasons:—1. Ordinary flames cast a shadow in sunlight, and it is difficult to believe that this can happen except by the intervention of solid particles; and carbon is the only solid substance which can be present. 2. Flames artificially made to contain solid particles have been shown to be as transparent as an ordinary gas flame. 3. If there be only heated vapour in such a flame, soot ought not to be deposited on a strongly heated rod held in it, whereas, as a matter of fact, soot is deposited under such conditions. 4. By causing one flame to meet another the particles of carbon may be made as it were to agglomerate, and a much coarser-grained soot is obtained. 5. The quantity of hydrogen in soot is extremely small, very much less than in the densest hydrocarbons. The small luminosity of a Bunsen flame has been usually ascribed to the complete combustion of the solid particles of carbon, but it has been shown that the previous admixture of nitrogen and other inert gases with the coal gas renders the flame almost non-luminous. This is probably due to the lowering of temperature produced by the admixture of a large volume of inactive gas, for the luminosity can be restored by heating the mixture before burning. In a Bunsen flame the added heat due to increased combustion probably overbalances the cooling effect of the admixture of air. That the heating of gas before it reaches the burner greatly increases the illuminating power is well known, and this principle has been applied practically in recent improvements in gas-lighting in England and Europe.

The Apricot Disease.

By F. S. Crawford.

[Read November 4, 1884.]

Two years ago I forwarded to Dr. M. C. Cooke leaves and fruit of the apricot—the former attacked with the "Shot-hole Fungus," and the latter with the pustular disease on the fruit, both which have been so common of late. I likewise mentioned that I thought there was a relationship between the two fungi. In reply Dr. Cooke stated that the shot-hole fungus was *Phyllosticta circumcissa*, and the pustular disease was caused by *Helminthosporium rhabdiferum*, and that the two fungi were entirely distinct.

Observations made during the last and present seasons have strengthened my suspicions that the two fungi are connected, and this opinion has been confirmed during the last few days by discovering several specimens of the shot-hole fungus on almond leaves in a state of fruit, the spores of which are precisely similar to those of the apricot fruit fungus, and which in shape resemble an *Helminthosporium*, and not a *Phyllosticta*.

In spite of the prevalence of the shot-hole fungus on the almond, cherry, plum, apricot, &c., it is a rare thing to find it showing spores. One day I discovered several spots on an almond leaf abounding with spores, but the next day failed to find any after a prolonged search, although to the naked eye the spots seemed precisely similar, and the leaves were taken from the same part of the tree. This may be owing to either the fruit spores growing very rapidly, and as quickly falling off, or else that a spore falling on a leaf gives rise to a mycelium, which grows, making the characteristic brown spot that soon drops from the leaf, but which only under exceptional circumstances produces spores in that stage of its existence.

In looking over Dr. Cooke's letters I am inclined to think that in naming the shot-hole fungus a *Phyllosticta* an error was accidentally made, because several other fungi were forwarded at the same time, and it was quite possible that one was a *Phyllosticta*; and as *P. circumcissa*, according to Cooke, makes shot-holes in the leaves of many plants, the mistake might thus easily arise. I also wish to point out that *Helminthosporium rhabdiferum*, according to "British Fungi," is found on ripe peaches, whereas I have never seen a peach, ripe or unripe, attacked with the "pustular eruption," although the leaves are to a slight extent affected with the "shot-hole"

fungus. I am, therefore, inclined to think that this disease is not the true *H. rhabdiferum* but an undescribed, species of *Helminthosporium*.

From an economic point, the fact of the shot-hole fungus and the apricot disease being the same is of importance. As the disease appears first on the leaves before attacking the fruit, it shows the necessity of combating the disease in this early stage, as well as not allowing comparatively valueless trees that are diseased to remain near young and healthy ones.

The following is the description of the spores of the shot-hole fungus:—Obovate or sub-fusiform, ·0014 inch long by ·00056 inch broad in centre; a single spore at extremity of a short peduncle from which it readily parts; of a very pale greenish-brown colour, almost hyaline; mostly tri-septate, many bi-septate, and a few 4-5 septate.

[December, 1885.—I take advantage of the proof of the above being forwarded for correction to add a few remarks. I found that during last winter, before all the almond leaves had fallen, that in the centre of the roundish-brown spots were generally to be found one or more tufts of a light brown colour, about $\frac{1}{120}$ inch in diameter, and which consisted of a great number of these spores growing on their peduncles. In early summer these tufts no longer appeared, although the brown discoloured spots became more numerous, which soon falling out formed the characteristic shot-holes. As soon as the fruit of the apricot begins to form, one or more very minute specks may be observed, but always on the upper side of the fruit; these specks increase in number and size until they make the brown scabs or "pustular eruptions." The scabby fruit is always most prevalent on trees that are most attacked with the shot-hole fungus, and always worse where the leaves are thickest over the fruit. Mr. Tepper informs me that Professor Ludwig, of Germany, had decided, from some almond leaves he had sent him, that they were attacked with *Sporidesmium amygdalearum*, but as Mr. Tepper is doubtful whether the Professor saw any spores, and as he was not aware of the supposed connection of the shot-hole fungus with the "pustular eruption" on the apricot, and as, moreover, the spores above-mentioned do not answer the description of a *Sporidesmium*, I am still of opinion that it is a true *Helminthosporium*.—F.S.C.]

On the Fossil Foraminifera from the Government Boring at Hergott Township, with General Remarks on the Section and on other forms of Microzoa observed therein.

By Walter Howchin, F.G.S.

[Read December 2, 1884.]

A short time ago a small quantity of material obtained from the Government boring at Hergott was placed in my hands by Professor Tate to examine in the hope that a careful search might reveal some forms of microzoa by which, at least, the marine character or otherwise of the beds through which the boring was carried might be determined. Mr. Clement L. Wragge, to whom Professor Tate was indebted for these samples, kindly added to their quantity. I am also placed under great obligation to Mr. Jas. W. Jones, the Conservator of Water, for his ready courtesy and liberality in placing other samples of the core at my disposal. By this means I have been enabled to test the microscopic contents of this geological section throughout its entire depth. The figures indicative of the various depths from which the samples were taken, I regret to say, are rather vague, but are the best information as to their respective geological horizons which was at my disposal; but this is of less consequence on account of the great uniformity of the beds through which the bore passed.

I would also acknowledge my indebtedness to the great work of my friend Mr. Henry Bowman Brady, F.R.S., on the Foraminifera of the Challenger Expedition, which has just been published by the British Government. When we take into account the great number of new species therein figured and described, the fulness of information on this particular field of zoological investigation which it supplies, and the new facts as to the distribution and bathymetrical range of the marine Rhizopoda, which are now for the first time made public, the work must rank as one of the most important contributions to the history of the Foraminifera that has ever been published. Mr. Brady has found it necessary, in working out the enormous quantity of new material which was placed in his hands, to rearrange some groups, and this necessitated some change in the nomenclature. I have in the following remarks adopted Mr. Brady's classification, which will un-

doubtedly be generally accepted by workers in this department of natural history.

Nine samples of material were washed and searched, in all, from the Hergott bore, on which the following remarks may be made:—

Remarks on the Section.

1. *Surface Bed.*—The surface, according to a sample submitted to me by Mr. Wragge, is a bed of loose sand, reddish in hue, and passing from very fine particles up to a shingle of small pebbles. The fragments are mostly quartz, and are for the most part rounded by attrition. The quartz presents the features of the transparent and milky varieties, and are often stained with iron. One or two organic remains were found in this sample when placed under examination. One of these was the single valve of a very minute bivalve shell, much weathered; also a small concave and hemispherical body, finely foraminated on its convex side; and in addition to these a few arenaceous tubular objects, the zoological character of which it is very difficult to determine. The lithological features of this surface bed are so widely different from the underlying that it evidently represents a totally different condition of things in its deposition. It may be after all only an alluvial wash, with a few organic remains mixed with the gravel, these having been derived from older beds. It would be interesting to know the exact thickness of this surface bed, and whether its parting from the underlying great silt bed is a sharply-defined line, or whether the finer silt of the lower passes gradually into the coarser beds that overlie it. The next sample, which is marked as only fifteen feet in depth, shows the passage from the one to the other at that depth to be complete.

2. *Fifteen feet from surface.*—A very fine argillaceous silt with a small proportion of mica. Has a compact appearance in its natural state, but goes down easily in water, and then swells out to several times its former bulk. The residuum left after washing the material and running off the light, flocculent particles, is exceedingly small, and is reduced to about one-twentieth of its original weight. Although no signs of organic remains could be detected in the mass before treatment, the results obtained after washing the material were very interesting. There are few objects of an organic nature present in this sample except Foraminifera, a single Entomostracan carapace and a trace of vegetable tissues making up the number. The Foraminifera are represented by ten species, one of which, *Pulvinulina elegans*, d'Orb., has only been found in the section at this depth, and there but a single specimen; the rest are all arenaceous forms.

3. *Twenty to forty feet from surface.*—The stratigraphical and lithological features of this sample correspond almost exactly with the preceding, having, perhaps, a slightly larger proportion of micaceous particles. Residuum very small in quantity. Under the glass this is shown to consist mainly of small flakes of the matrix not dissolved by the washing, and a considerable number of fragments made up of very minute crystalline particles. The majority of these are apparently aggregations of crystals; but scattered amongst the material are a few objects somewhat similar in appearance to these crystalline bodies, because built up of like particles, but of organic origin. These coarsely-arenaceous Foraminifera, of which there are seven species recorded from this washing, make up nearly the whole of the fossil contents from this depth. The remainder consist of one or two very minute fragments of carbonaceous matter and a few other fragmentary objects, probably of organic origin, but too imperfect to show their zoological relationships.

4. *Forty to fifty feet from surface.*—The general features of this sample resemble very closely the preceding, being evidently a continuation of the same bed of argillaceous silt. Seven species of Foraminifera occur, none of which are peculiar to the geological horizon. This sample is, however, of some interest in supplying a single valve of *Lingula* and two other fragments, which appear to belong to the same species. It is so small a shell as to require a magnifying glass to determine its character. The only other objects worty of note are a detached cell of a polyzoan (the only indication of polyzoanal life found in the entire section), small fragments of drift-wood, a (?) seed case, and a few pyritous casts which are globular or cylindrical in shape, the latter are straight, serpentine, and rarely bifurcating.

5. *Fifty to fifty-five feet from surface.*—Lithological character similar to preceding. The amount of material operated upon from this depth was very small, but moderately rich in its foraminiferal contents. These latter belong to eleven species under seven genera. A trace of molluscan remains was observed in the form of one or two small shell fragments; also one Entomostracan, several seed or egg cases of a brown colour, and small fragments of vegetable matter.

6. *One hundred to two hundred feet from the surface.*—The material from this depth placed at my disposal consisted entirely of the casts of a molluscan bivalve, about the size of a cockle shell. One or two of the least perfect of these casts were dissolved in water, and these left a rather larger proportion of residuum than usual in these washings, in consequence

of the somewhat stronger character of the matrix. This less degree of solubility appears to be owing simply to the distribution of small crystals of iron pyrites scattered through the mass and binding it together. The amount of material thus searched was very small, yet it proved to be the richest sample in its palæontological contents of the whole section. The Foraminifera number thirteen species, in no less than nine genera. Two genera are peculiar to this particular geological horizon—*Verneuilina polystropha* and *(?) Endothyra Bowmani*, the latter a characteristic Carboniferous form, of which we shall say more presently. The associated remains consist of fish bones, including several split vertebræ, a highly decorated Entomostracan, comminuted shells of mollusca, and some vegetable matter.

7. *Two hundred feet from surface.*—A separate sample thus labelled was supplied to me by Mr. Jones. This contains but three species of Foraminifera, but of these *Cristellaria rotulata* is peculiar to this washing, and it is also the best horizon for *Marginulina*. Next to the Foraminifera the most interesting feature of this material is in the occurrences of several fragments of *Dentalium*, a gasteropodous mollusc which has a wide range in geological time. There are also indications of bivalves, fish bones, and a few small cylindrical casts. [Three additional species have since been determined from this depth from mountings submitted to me by Mr. G. Goyder, jun.]

8. *One hundred to three hundred feet.*—The great silt bed appears to be little altered in character even at this depth. The fossil contents are few and weathered. Only three species of Foraminifera were noted. One of these—*Marginulina*—appears to be limited to about this depth, as it was only noted in this and the preceding sample. A few molluscan fragments also occur.

9. *Three hundred and four feet to three hundred and six feet from surface.*—In this washing a marked change in the stratigraphical character of the bed is apparent. The matrix is still a fine argillaceous silt, but it is studded with a large number of small stones and pebbles, mixed with quartz and a green mineral, which is probably glauconite. The enclosed pieces of rock are much water-worn, and indicate a littoral deposit formed in close proximity to land. In consequence of the large proportion of insoluble material in the rock stuff, the residuum left from washing was much greater than in the previous samples. Organic remains at this depth are very scarce, but the relatively greater proportion of residuum may partly account for this apparent scarcity of organic remains. The Foraminifera are represented by only four species, and

these were for the most part single examples of their kind. In addition to some irony-looking casts there occur a few fragments which carry the lustre and colour commonly seen in fossil bone. An examination by sections of a considerable number of specimens of this kind, in this and the following sample of material, has led me to conclude that they are shell remains of an unusual colour. Some of the fragments appear as though they had been perforated by some boring annelid. There was also found in this sample a fragment which belongs probably to the calcareous algæ.

10. *From three hundred and six feet to three hundred and nine feet from surface.*—This, like the preceding, is evidently a littoral deposit, and the two samples must be stratigraphically associated. When examined under a lens it is seen to be made up almost entirely of a fine-grained sandstone that has been broken down by some denuding forces and subjected to attrition. The sand grains are for the most part very small, and have evidently been derived from a soft sandstone that formed the shore line. Some of the fragments of rock enclosed in this bed are white and others of a greenish hue, the latter being in sufficient quantities to give a decided greenish cast to the bed. The organic remains are few. The most numerous of these consist of the smooth and polished objects referred to in the preceding sample, and these show evidences of wave action in their abraded edges. Only two species of Foraminifera occur, but one of these, *Placopsilina cenomana*, d'Orb., is peculiar to this sample, and forms an interesting addition to the list.

Remarks on the Species.

Hyperammina vagans, Brady.—This is an arenaceous Foraminifer, possessing an undivided and unbranched tube which follows most tortuous lines, being often coiled on itself, not unlike some marine annelid growths. It possesses a primordial chamber of a round or oval shape, which is inflated and slightly larger than the tubular extension. In the Hergott material there is one example of the tube coiled and two examples of the primordial chamber which are of an oval shape. The collection made by the Challenger shows that this species has an almost universal distribution in the seas of the present day—from Spitzbergen to Kerguelen Island. It seems to prefer a cold habitat, as in the Arctic seas it comes within fifteen fathoms of the surface, whilst in the great ocean depths it was dredged from a depth of 2,900 fathoms, where a similar Arctic climate prevails. This form has been recently found in the Jurassic rocks of Switzerland by Dr. R. Haeusler, and has been described and figured by him in the "Quarterly Journal of the Geological Society" (Feb. 1, 1883). There is also a

strong probability this this species occurs as a Silurian fossil, as Messrs. Nicholson and Etheridge, in their monograph on the Silurian fossils of Girvan, in Ayrshire, have described a tubular organism which Mr. Brady considers to be none other than the species now under consideration. Its simple structure gives probability to its being an archæan type, and the wide distribution of the form at the present day shows it to be capable of a ready adaptation to varying conditions. Its obscure character and close resemblance to other zoological types may be the reason why it has been completely overlooked as a geological species until recently.

(?) Thurammina papillata, Brady.—*Thurammina* is a new genus founded by Mr. H. B. Brady to include some single chambered and arenaceous Foraminifera which usually show more or less perforated papillæ on their exterior surfaces. This species is often spherical, but is subject to great variation in outline. In the Hergott material there are a few spherical and arenaceous Foraminifera which we have referred to this genus. The papillæ are not very well defined in the examples I have obtained, but they show a pimpled surface suggestive of papillæ. Their less perfect appearance may be caused by the compression to which these, as well as nearly all the species from Hergott, have been subject. More perfect specimens might indicate that these forms belong to some closely-allied genus, but for the present they may be classed with some reserve as above. *Thurammina papillata*, like *Hyperammina vagans*, is a denizen of all seas at the present day where deep water occurs, but is not often found at less depths than 500 fathoms. Dr. Haeusler found this species associated with *Hyperammina vagans* in the Jurassic rocks of Switzerland, already referred to, and it is rather curious that a similar assumed companionship in these two genera should have occurred in the case of South Australian palæontology.

Reophax scorpiurus, Montfort.—The genus *Reophax*, as now defined by Mr. Brady, includes all the free, non-spiral, and non-labyrinthic *Lituolæ*. The general characters of the genus are a coarsely arenaceous test, with a single inflated chamber, or a number of such chambers strung together in a series, which may be either straight or crooked. *Reophax scorpiurus* is so named from its supposed likeness to a scorpion, having a tapering and often upturned end. It is represented in the Hergott material at three distinct horizons, all under 200 feet. It is by no means a common form in any of the washings, being more generally represented by its starved variety, *R. fusiformis*, to be referred to presently. In existing seas *R. scorpiurus* is widely distributed, and generally pretty common where it occurs. It has an equally wide bathymetrical range, and seems

at home in either hot or cold areas. It has been noted from the shallows down to 4,000 fathoms. As a fossil it occurs in the Oolite of France, Jurassic of Switzerland, and Post-Tertiary of Norway.

Reophax fusiformis, Williamson.—This is a one-chambered variety of *R. scorpiurus*, and represents uncongenial and shallow-water conditions. It is the commonest species of the foraminiferal fauna in the Hergott section. This is an interesting fact when considered in relation to its known range and distribution. It is not a common form in the present day. It has been taken in the North Atlantic and sparingly off the British coasts. To these localities the Challenger only adds a single one, off the Phillippine Islands, at 95 fathoms, whilst the species has not been previously known to occur in a fossil condition. It was not found in the Hergott material at a greater depth than 200 feet.

Reophax ampullacea, Brady.—This is a flattened variety of *R. difflugiformis*, Brady. Circular at the base, and tapering at the distal end; much compressed. One or two examples which appear to belong to this variety were found in the Hergott material, but it is much rarer than its allied species. The species was founded on Challenger specimens, and these taken at only one station, off Kerguelen Island, in 120 fathoms.

Haplophragmium agglutinans, d'Orb. — This is a coarsely arenaceous crosier-shaped form that can be easily distinguished. It occurs in moderate numbers in the upper portions of the Hergott section. It varies considerably in size, and is built up of very coarse grains of sand. The linear portion is often absent in these specimens from Hergott, probably through being broken off either beforehand or by the attrition caused by the washing. The septal lines are also obscure in these specimens, arising from the very coarse texture of the test; and the rectilineal portion, instead of gradually enlarging towards its extremity, as is generally the case, sometimes tapers to a point. *H. agglutinans* is to be found in all seas at the present day, and although it is sometimes taken in shallow waters, Mr. Brady says it is essentially a deep-sea species, from 500 to over 3,000 fathoms. I have taken it, however, in about two feet of water in the Port Creek. It is known as a Liassic, Lower Tertiary, and Miocene fossil.

Haplophragmium agglutinans, var. *rectum*, Brady. — This variety was named by Mr. H. B. Brady some years ago from a few specimens found in the Lower Carboniferous rocks of Yorkshire. It is a delicate variety, with a very small spiral-line development in comparison with the length of the linear portion. This variety passes into the typical species by every

intermediate gradation, and on this account Mr. Brady has, in his work just published, made *H. rectum* a synonym of *H. agglutinans*. But I think the name may be very well retained as a varietal distinction. In the material now under review they assume very distinct appearances without any intermediate forms that I have observed.

Haplophragmium (?) Canariense, d'Orb.—There are a few small nautiloid examples of *Haplophragmium* in most of the samples from Hergot, but they are in all cases very badly preserved, having been subject to much compression and consequent distortion. In some instances the pressure has been applied laterally, by which the two sides of the shell have been crushed together, and in others the pressure has operated on their peripheral margins, so as to reduce them to an oblong shape. In consequence of such distortion the determination of these minute species is a matter of some difficulty, and has been impossible in the short time and meagre material at my disposal. Some of the best preserved specimens show a resemblance to *H. canariense*, to which I have for the time being relegated them; but it is probable that with better specimens at command it will be found that there are more than one species brought under this determination. Dr. Stache, of Vienna, has figured two species of *Haplophragmium* from the Tertiaries of New Zealand, and it is not unlikely that the examples in Hergott material may possess specific relationship to these. *H. canariense* is of world-wide distribution, although, unlike *H. agglutinans*, it is a characteristic shallow water species. It has not been hitherto known as fossil in rocks earlier than the Pleistocene.

Haplophragmium, sp.—Two examples of what appear to be an undescribed form of this genus were found, one at a depth of about 45 feet and the other at about 200 feet. They consist of a single whorl of large inflated chambers, few in numbers, and in consequence of the large chambers making a sharp turn in the convolution, the septal lines are at very different angles with regard to each other. These await further elucidation.

(*?*) *Nodosinella*, sp.—There are a few straight or slightly curved nodosariform Foraminifera in the material which have been provisionally referred to this genus. The test is rough, apparently finely arenaceous, septation often obscure. None of the examples appear to be in a perfect condition, and their general features seem to indicate a closer relationship to the Carboniferous genus above quoted rather than any other of the Nodosariform group. Nodosinella has not been known hitherto outside of the Carboniferous formation, in which some of its specific forms are widely distributed. Better specimens

may show these Hergott forms to belong to something else, but for the time being we cannot give them a better classification.

(*?*) *Endothyra Bowmani*, Phillips.—A few examples of a Rotaliform Foraminifer occur at a depth of something under 200 feet that seem undistinguishable from *Endothyra Bowmani*. The *Endothyræ* have been so far only known as a Carboniferous type, and the particular species now referred to may be considered the most characteristic of all the Carboniferous Foraminifera. Its occurrence, therefore, in another geological formation, and one presumably of a much later age, is a point of great interest. In size the examples obtained from Hergott are smaller than the average Carboniferous specimens, but they show a close morphological resemblance to the Palæozoic forms. The same is true of the structure of the test, which in the *Endothyræ* generally is a very fine sub-arenaceous investment. From examination of the Carboniferous specimens Mr. Brady concluded the test to be imperforate, and a careful examination of several transparent sections taken of the Hergott specimens confirms this view, as no perforation of the test walls could be determined. All the examples taken of this interesting species in the Hergott material were obtained by washing down the rough casts of bivalves, already referred to, and indeed the rich gathering of Foraminifera obtained at this depth were all such as had been drifted with the mud into the shells of these molluscs, as they were rendered empty by the death of the shell-fish. Whether these shells afforded the necessary protection against pressure or not I cannot say, but the Foraminifera obtained from their casts were free from that distortion which is so common in the rest of the section.*

Bigenerina.—This is a dimorphous Foraminifer, being Textularian in its earlier growth and Nodosarian in the later chambers. It is one of the most characteristic and interesting of the Hergott forms. The genus is present in the material in two species, *B. nodosaria* and *B. digitata*. The examples might rather, in most cases, be considered as intermediate to these two forms. For the most part *B. nodosaria* approaches *B. digitata* in a more uniform outline, with a

*I have since sent all my mounts of this form, together with the transparent sections, to Mr. H. B. Brady, for his opinion regarding them, and in a letter bearing date of October 15th, 1885, he states :—"Had I found them in beds of Carboniferous age I should certainly have assigned them, as you have done, to *Endothyra Bowmani*, and this under most circumstances should be final. Nevertheless, I cannot speak with positiveness. The surface of the test appears to me granular and corroded rather than really arenaceous. On the other hand I cannot obtain any satisfactory evidence of perforation. Provisionally I should be inclined to assign them to *Endothyra Bowmani*, with some reservation in favour of *Planorbulina* (*Anomalina*) *ammonoides*, or one of the allied Secondary forms."

blunter and more obtuse point than is usual in typical examples; whilst, on the other hand, *B. digitata*, in the Hergott material, is often of the same colour as *B. nodosaria*, and approaches more nearly that species in outline.*

The genus *Bigenerina* is a very ancient one, if Mr. Brady's Carboniferous species, *B. patula*, belongs to this genus. Dr. Dawson has also figured what appears to be the same species from the Laurentian of Canada, and is there associated with the much-disputed *Eozoon Canadense*. The genus is not met with in the Secondary rocks, and the two species to which the Hergott examples are referred make their first appearance, so far as hitherto known, *B. nodosaria* in the Miocene of Vienna and Malta, and *B. digitata* in the later Tertiaries of Italy. The distribution of these species in existing seas is somewhat restricted. *B. nodosaria* is common in the North Atlantic, where it occupies shallow water; it is much rarer in the Mediterranean and North Pacific, but in the southern hemisphere Mr. Brady describes it as "exceedingly rare," being only found at one point in the South Atlantic. *B. digitata* is only known as a European form. The examples in the Hergott beds would imply that these species have had a much wider range in geological times than exists at the present day. Two examples, unfortunately broken, of a much coarser and more robust species of *Bigenerina* were found in one sample of material from Hergott, but these are too imperfect specimens to be dealt with at present.

Gaudryina pupoides, d'Orb.—The genus *Gaudryina* comprehends another dimorphous form of the Foraminifera, in which the earlier chambers follow a triserial arrangement and then pass in their later growth into a biserial order. Its geological history begins with the Cretaceous period, and it is found in most later formations to the present day. The examples from Hergott belong to two species. The most characteristic and plentiful of these species, we have referred to *G. pupoides*, as it possesses in common with that species large and inflated chambers towards the oral extremity, whilst it tapers rapidly towards the primordial end, is finely arenaceous in texture, and possesses a projecting terminal orifice similar to *G. siphonella*. These examples are all more or less flattened, which renders determination the more difficult, but they can very well be classed with *G. pupoides* until better specimens are found to disprove this relationship. In existing seas this species is common in deep water, and occurs in the Challenger gatherings from all parts of the world. It is known as far

* I have more recently obtained very characteristic examples of *B. digitata* from the Tarkaninna Bore, which is in the same geological formation.

back as the Gault, and is most common as a Cretaceous fossil. A single example of this genus was found at a depth of forty-five feet which is both longer and more tapering than those just described, but whether this is simply an individual departure from the typical form or is a member of another species cannot be determined on the evidence of a single example.

Gaudryina (?) scabra, Brady.—This is one of the new species which Mr. Brady has figured from the Challenger dredgings. It has an elongated tapering test, the oral end being broad and rounded, with the opposite extremity obtusely pointed. The triserial portion of the shell forms but a very small proportion of the whole. The aperture is an arched fissure at the inner margin of the last segment. It is rather coarsely arenaceous, and of a brownish colour. This species was taken at only two of the Challenger's stations, and these near together, off Sombrero and Culebra Islands, at depths of 450 fathoms and 390 fathoms respectively. It occurs both in the upper and lower portions of the Hergott section. It apparently agrees closely with Mr. Brady's figures and description of the species, even to the brown colour of the test, of which it shows some trace ; but as the examples taken are very limited in number, I have chosen to refer this species as above with some reservation.

Verneuilina polystropha, Reuss.—This is a triserial Foraminifer, with very distinct globose chambers, and is coarsely arenaceous. It is a shallow-water species, seldom being found at a greater depth than 50 fathoms, and has its habitat on muddy bottoms and in estuaries. It is most common in the North Atlantic and Mediterranean, but it has also been found on the coast of Ceylon and on the east coast of Australia. In geological formations it is only known as a Post-Tertiary Foraminifer. Only one example was obtained from the Hergott material, at a depth of 200 feet., but this was perfectly characteristic of the species.

Placopsilina cenomana, d'Orb.—This is a very simple, tubular, and parasitic Foraminifer, often spiralline in the earlier portion, and soon becoming very irregular in growth. It is a parasitic form, and is often found growing on the surface of shells, corals, &c. It is not a very common form at the present day. It is recorded from one of the stations dredged by the Porcupine in the North Atlantic. It is also known as a Mediterranean species, and the Challenger record gives the additional localities of the South Atlantic and the coral reefs of the Pacific. Its home appears to be in the shallow waters of the tropical seas. Two or three examples which may be referred to this species were found in the Hergott material, but all these are from one horizon—and this the lowest of the section

—at 306 feet depth. As it is an adherent form, the absence of objects from the fine silt of the upper portions of the section, which are necessary for the preservation of this form, may account for its absence in the higher horizons. The examples found are attached to fragments of shell or small flakes of shale, but in none of these is the spiralline form apparent. Its geological history dates from the Lower Lias of France ; it is also found in the Lias of France and England, and the Lower Oolite and Cretaceous rocks of Europe, but has not been found in any of the Tertiaries.

Lingulina carinata, d'Orb.—The genus *Lingulina* represents simply a compressed and straight *Nodosaria*. The genus is scarce in the seas of the present day, except in the tropical and subtropical portions of the Atlantic. It is known to exist as far back as the Lias, but it appears to have been always a form possessing but a limited distribution. *L. carinata* is the only species of the genus that occurs in the Hergott section, and but two examples were found. They agree with the figures usually given of this species, but one of the examples obtained has a peculiar inflation of the last segment, which is both larger and rounder than the earlier chambers, and approaches very closely to the Nodosarian character.

Cristellaria rotulata, Lamk.—Two or three fragments apparently belonging to this species have been found at Hergott. No perfect examples have been procured, but by comparing the much-weathered fragments one with another it seems moderately certain that the above is the species to which they belong. This is perhaps the most widely distributed of all the Foraminifera, both as to geographical limits and bathymetrical range, as well as geological time. It is recorded as belonging to almost all geological formations from the Upper Trias of Derbyshire downwards.

Cristellaria gibba, d'Orb.—This is a variation of *C. rotulata* in the direction of *C. crepidula*. That is, the oral extremity is drawn out so as to give an oblong shape to the shell, which is compressed. There are often found a complete series of forms from the almost circular *C. rotulata* to the extremely drawn out *C. crepidula*, with every shade of intermediate modification. D'Orbigny's *C. gibba* stands for the intermediate stage when the crepidulate tendency has been arrested. Its distribution is confounded with allied varieties. Mr. Brady notes its occurrence in North Atlantic and South Pacific at less than 500 fathoms. Its geological range has hitherto dated from the Cretaceous downwards. The examples in the bore material are few, but characteristic.

Marginulina glabra, d'Orb.—This genus unites the Cristellarian and Nodosarian features, with a marginal aperture ; and

on account of being slightly compressed has an oval transverse section. *M. glabra* has a wide range as to depth in the present seas, and is very generally distributed. It is as old as the Upper Lias, and frequently occurs in geological formations of a later date. It is rare in the Hergott material, and none of the examples are perfect.

Pulvinulina elegans, d'Orb.—There is but a single example of this pretty little shell recorded from Hergott. It is small in size, and does not show such a strongly-made test as the species often carries, and is probably a young example. The species is common in the North Atlantic and South Pacific, and also occurs in the Mediterranean. Its geological range dates as far back as the Trias, and it is also known as a Liassic and Tertiary form. It thrives best at moderate depths, from the littoral zone down to 700 fathoms.

Subsequent to the reading of this paper Mr. G. Goyder, jun., sent me a few micro. mounts selected from material taken from about 200 feet depth in this boring, and from which I have been able to determine the three following species as additions to those described above :—

Nodosaria radicula, Linné.—This species is the most typical of the *Nodosarinæ*, has a wide distribution at the present day, is common to both shallow and deep water, and is a common fossil in many microzoic rocks, from the Permian downwards.

Polymorphina lactea, Walker and Jacob.—Common in most seas at present day, but especially the shallows of temperate waters. It is not known much further south than the Cape of Good Hope, and is fossil in Kimmeridge Clay and later.

Vaginulina legumen, Linné.—A pod-like, slightly curved, compressed Nodosarian, widely distributed in present times, and dating from Trias.

General Considerations.

The section is remarkable for the uniformity of its stratigraphical features. With the exception of a few feet at the surface and a few feet at the base of the section, it is practically but one bed extending through a depth of 300 feet. In its fresh condition it would have appeared as a bed of dark mud. The homogeneous character of the sedimentary matter, through so great a depth, implies that the physical conditions which prevailed during its deposition were of a very regular and persistent kind. Not only stones, but sand also, may be said to be absent from this great silt bed, as the grains of quartz visible in most of the washings were so few as to be almost inappreciable. It must have been a landlocked sea or

estuary where the deposit occurred, with still water, and yet exposed to a feeble current that brought a light sediment from no very distant land, which settled down to the bottom within its quiet area. Small crystals are widely distributed throughout the mass, and a few thin beds of limestone were passed through by the drill, that show a dark colour, with spar veins running through the mass tinged with green. The limestone is calcareous, open in texture, and highly crystalline. The Hergott section rests on Primary rocks, and the last nine feet in the bore is evidently a littoral deposit giving indications of a shore line, containing pebbles of quartzite, rounded fragments of chloritic and other schists, which tell the tale of wave action on the shore as the land began to sink beneath the waters.

The section is pretty evenly fossiliferous, but the horizon at which the large bivalve casts occur, at about two hundred feet, has yielded the greatest number of forms, whilst the last nine feet at the base of the section have given the fewest. The palæontological features are restricted in range and belong almost entirely to one group of organisms. About twenty-five species of Foraminifera have been observed, and of these something like seventeen, or nearly three-fourths of the whole number, belong to the arenaceous type. This is a very unusual proportion, as the Foraminifera with calcareous and hyaline tests generally far outnumber those of an arenaceous investment. Of the well-marked species in the list only one can be considered a deep-water species; ten have their habitat in shallow water, and ten are common to both. From this analysis we may safely conclude that the sea in which these Foraminifera lived was of no great depth. It is not so easy to determine their geological age. One and perhaps four species date from Palæozoic times, thirteen are known as Secondary forms, two begin their geological history in the Tertiaries, and five have not been known previously in the fossil condition. The Foraminifera generally, as an order, are of little value in determining geological synchronism. They yield the oldest of all known existing species, and are at one and the same time the most variable and the most persistent of zoological types. The palæontological evidence outside of the Rhizopodal fauna is equally indeterminate of the age of these beds. The large bivalves, so far as I have seen them, are mere casts with a chalky coating, and the two genera that are capable of determination, viz., *Lingula* and *Dentalium*, are both common geological genera dating from early Palæozoic times. The example obtained of the former was microscopic, and of the latter broken into small fragments so as to preclude specific identification. The beds in question have been variously referred to the Jurassic and the Cretaceous periods. They are

undoubtedly Mesozoic, but there is nothing in the microzoa detailed above that throws any light upon their exact geological age.

TABLE showing occurrences and depth of the FORAMINIFERA obtained from the Hergott Bore, their bathymetrical range at the present day, and their geological age as hitherto known.

Family.	Genera and Species.	Depth from Surface in ft.										S. Shallow Water D. Deep Water C. Comm. to both	P. Palæozoic M. Mesozoic T. Tertiary R. Recent
		15	20-40	40-50	50-55	100-200	Bivalves	200	100-300	304-306	306-309		
ASTRORHIZIDÆ—													
Sub. Fam. *Rhabdammininæ*	Hyperammina vagans, *Br.*				x					x		C	M(?)P
LITUOLIDÆ—													
Sub. Fam. *Lituolinæ*	Reophax fusiformis, *Will.*	x	x	x	x	x						S	R
" "	" ampullacea, *Br.*	x			x							S	R
" "	" scorpiurus, *Montf.*		x		x	x						C	M
" "	Haplophragmium agglutinans, *d'Orb.*	x	x	x	x							C	M
" "	" " *var.* rectum, *Br.*	x	x		x	x			x			C	P
" "	" (?) canariense, *d'Orb.*		x	x	x	x		x	x	x		S	R
" "	" species			x		x							
" "	Placopsilina cenomana, *d'Orb.*										x	S	M
" *Trochammininæ*	(?) Thurammina papillata, *Br.*	?			x							D	M
" *Endothyrinæ*	(?) Nodosinella sp.	x				x							P
" "	(?) Endothyra Bowmani, *Phil.*					x							P
TEXTULARIDÆ—													
Sub. Fam. *Textularinæ*	Bigenerina nodosaria, *d'Orb.*	x		x		x						S	T
" "	" digitata, *d'Orb.*	x			x	x						S	T
" "	Gaudryina pupoides, *d'Orb.*	x	x	x	x							D	M
" "	" (?) scabra, *Br.*			x		x				x	x	C	R
" "	Verneuilina polystropha, *Reuss*					x						S	R
LAGENIDÆ—													
Sub. Fam. *Nodosarinæ*	Nodosaria radicula, *Linné*							x				C	P
" "	Lingulina carinata, *d'Orb.*		x			x						S	M
" "	Cristellaria rotulata, *Lamk.*							x				C	M
" "	" gibba, *d'Orb.*				x	x						S	M
" "	Marginulina glabra, *d'Orb.*							x	x			C	M
" "	Vaginulina legumen, *Linné*							x				C	M
" *Polymorphininæ*	Polymorphina lactea, *W. and J.*							x				S	M
ROTALIDÆ—													
Sub. Fam. *Rotalinæ*	Pulvinulina elegans, *d'Orb.*	x										C	M

Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a Description of a New Species of Rhynchonella.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

The following notes are addenda to my paper on "The Palliobranchs of the Older Tertiary of Australia," published in these transactions for the year 1880:—

I. New Species.

Rhynchonella Baileyana, *Tate*. Plate vi., figs. 3*a*—3*c*.

Ref.—Southern Science Record, January, 1885, p. 1.

Shell transversely ovate-trigonal, sub-depressed; dorsal valve regularly convex from the umbo to the middle, thence flattish to the front of the mesial fold, which is broad and not very prominent; the ventral valve is less convex, with a broad sinus of moderate depth commencing at half the distance from the beak and extending to the front. The anterior-fourth of each valve is plaited and circumscribed by a conspicuous fold of growth; there are seven plaits on the mesial fold and about four on each lateral area. The mesial fold occupies about one-third of the front of the shell, rising abruptly from the lateral areas. The beak is very small, moderately produced, with a minute circular foramen under its angular and slightly-incurved extremity which is surrounded and separated from the hinge line by a deltidium of two pieces.

Length, 25; breadth, 18; thickness, 12 millimetres.

The species is dedicated to the memory of Mr. John F. Bailey, late of Melbourne, to whose enthusiasm for science he recently fell a martyr, by whom it was collected at Jemmy's Point, at the entrance to the Gippsland Lakes.

Rhynchonella Baileyana is an interesting addition to the palliobranch fauna of the Australian Tertiary period, inasmuch as it differs so widely from living and Tertiary species, and recalls some Mesozoic ones. I do not know of any other fossil which has so depressed and broadly oval form conjoined with marginal plications and a small sub-erect beak as it possesses

II. Species still Living.

Rhynchonella squamosa, *Hutton*.

This species in a living state was taken off south of Kerguelen Island during the Challenger expedition, and has been redescribed by Mr. Davidson in Brachiopoda of the Challenger Exped., t. 4, f. 14, p. 59 (1880), as *R. nigricans*, var. *pixydata*.

III. Additions to the Provincial Lists of Species and Localities.

Victoria.—Terebratula vitreoides, *T. Woods*. Muddy Creek. J. Dennant!

Waldheimia Garibaldiana, *Davidson*. Corio Bay!

insolita, *Tate*. Corio Bay! Muddy Creek, near Hamilton, and Limestone Creek, near Ascot, Glenelg River. J. Dennant!

grandis, *T. Woods*. Limestone Creek, J. Dennant!

Terebratulina Scoulari, *Tate*. Balcombe and Corio Bays!

lenticularis, *Tate*. Corio Bay!

Magasella compta, *Sowerby*. Mordialloc, J. F. Bailey! Muddy Creek, J. Dennant!

Rhynchonella Baileyana, *Tate*. S. Gippsland, J. F. Bailey!

Tasmania.—Extracted from paper by Mr. R. M. Johnston in Proc. Roy. Soc. Tasm. for 1884, p. 223:—

Waldheimia furcata, *Tate*.

Johnstoniana, *Tate*.

grandis, *T. Woods* (*!*)

Corioensis, *McCoy*.

pectoralis (?), *Tate*.

Terebratulina Scoulari (?), *Tate*.

lenticularis, *Tate*.

triangularis, *Tate* (*!*)

Terebratella Tepperi, *Tate*.

South Australia.—From the clayey sands with green grains pierced by the bore sunk at the Waterworks Yard, Adelaide:—

Terebratula vitreoides, *T. Woods*.

Waldheimia insolita, *Tate*.

Terebratulina Scoulari, *Tate*.

lenticularis, *Tate*.

Terebratella furculifera, *Tate*.

IV. Species Common to the Older Tertiary of Australia and New Zealand.

Magasella Woodsiana, *Tate*. (*Waldheimia tapirina*, Hutton.)

Terebratula Aldingæ, *Tate*.

Terebratella furculifera, *Tate*.

Waldheimia insolita, *Tate*.

Terebratulina Scoulari, *Tate*. (*Waldheimia Suessii*, Hutton.)

Rhynchonella squamosa, *Hutton*.

The first identification is on the authority of Prof. F. W. Hutton, by whom it has been communicated to me *in litteris;* the others are based upon comparisons of actual specimens made by myself.

The Lamellibranchs of the Older Tertiary of Australia. (Part I.)

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 6, 1885.]

Plates II.—XII.

FAMILY OSTREIDÆ.

Genus Ostrea.

SYNOPSIS OF SPECIES.

I. Valves radially ribbed, spinose.	*O. hyotis.*
II. Valves foliated or smooth—	
Elongate; beaks produced	*O. Sturtiana.*
Oblong; beaks subspiral.	*O. arenicola*
Broadly attached, with erect front; beaks depressed.	*O. hippopus.*

Subgenus Gryphæa.

Umbo of lower valve largely incurved.	*G. tarda.*

Ostrea hyotis, Linn. Plate vi., fig. 5.

Ref.—Reeve, Monogr. Ostrea, t. 4, fig. 7.

"Shell irregularly subquadrate, solid, armed with tube-shaped spines standing out upon the angles of about seven large folds; auricles rather compressed foliaceous plicated."—*Reeve.*

I refer a very common oyster in the Middle Murravian series, with some hesitation, to the above-named species inhabiting the Indian Ocean; the fossil, however, rarely exhibits tubular spines, more generally broad foliaceous scales; in shape it varies from subquadrate to semicircular and obliquely oblong; the plications usually angular, are sometimes rounded when it approaches to *O. imbricata*, Lamk. In the absence of examples of the fore-named living species, I refrain from separating our fossil.

Dr. K. Martin has figured, under Linnæus' name, an oyster from the Older Tertiary of Java,* a variety of which is oblong. According to this author, the same species occurs in the Indian Tertiary beds, whence it has been described as *O. tubifera*, Sowerby in Trans. Geol. Soc., v., tab. 25, fig. 19., 1837.

Localities.—Calciferous sand rock, River Murray-cliffs at

* Die Tertiarshichten auf Java, p. 125, t. 21, figs. 1 and 2, 1880.

Mannum, Blanchetown, Morgan, &c., very common ; mouth of the Onkaparinga River, St. Vincent Gulf, one example (*R.T.*).

Ostrea Sturtiana, *spec. nov.* Plate vi., fig. 1.

Shell narrowly oblong to subtrigonal, test very thick, margins not denticulated; upper valve nearly flat, ornamented with depressed lamellæ, margin included in the lower valve, which is attached by a small part of the umbonal area or apparently free. Lower valve moderately deep, externally radially wrinkled and scaly lamellose; hinge of lower valve narrow, elongated, deeply and broadly channelled in the middle; hinge of upper valve shorter and broader. Muscular impression very large, somewhat reniform.

Dimensions.—Height, 85; breadth, 53; thickness through both valves, 40 millimetres.

Among recent species it approaches some varieties of *O. edulis*, but on account of its ponderosity, dissimilar ornament of the valves, and the large hinge, it may usefully have a specific designation applied to it. And I associate with it the name of Captain Sturt, who refers to this species under the name of *O. elongata*, Deshayes (*O. cucullaris*, Lamk.).

Locality.—This species constitutes banks up to ten feet or more in thickness in the upper part of the River Murray-cliffs from Overland Corner to beyond Blanchetown.

Ostrea arenicola, *spec. nov.* Plate x., fig. 6.

Shell roundly-oblong, somewhat produced anteriorly, rather compressed, solid, valves not very unequal; umbos depressed, slightly bent forwards. Lower valve moderately convex, attached by a small part of the umbonal area or free; marked with many roundly depressed radial ribs and foliaceous lamellæ. Upper valve flattish or sharply convex, smaller than and included within the lower valve, marked with flattened imbricating lamellæ.

Dimensions.—Height, 80; breadth, 85; thickness through both valves 25 millimetres.

The nearest ally is the southern analogue of *O. edulis*—the Port Lincoln oyster, *O. Angasi*—from which it differs in the depressed and forward-directing umbos, in the greater width at the front, and more decidedly costated; by the same characters it is separated from *O. Sturtiana*.

This species is usually found in the sand-beds alternating with the hard calciferous sandstones which form the topmost of the fossiliferous strata at Adelaide and in the cliffs at Aldinga Bay. It has seemingly been the habit of the species to attach themselves to one another or to be free.

Examples attached by a moderately large surface resemble

O. corrugata, Hutton, but the single specimen of that species which I possess is too imperfect for critical comparison.

An extreme variety occurs in the Upper Murravian at the North-West Bend, attached to *Meleagrina* by whole surface, except a narrow erect expansion which is externally laminated and occasionally plicatedly wrinkled; the upper valve is smooth and has the pointed recurved umbo so characteristic of the Aldinga specimens.

A thin-shelled form, having much resemblance to the last variety, which was obtained from the Adelaide bore may for the present be associated therewith.

Localities.—Upper Aldinga series at Aldinga and Adelaide.

Var. *a.*—Upper Murravian, North-West Bend, on the River Murray.

Var. *b.*—Lower Aldinga series at Adelaide. A minute valve having a thick test showing irregular structure from Schnapper Point, Hobson's Bay.

Ostreahippopus, *spec. nov.* Plate iv., figs. 1*a*—1*b*.

Shell suborbicular, inequivalve; hinge-line straight, umbo depressed, sub-central. Upper valve nearly flat, undulose towards the margin, which is included within the lower valve; surface with irregularly concentric lamellæ. Lower valve attached by a very large surface with an erect margin, which is externally faintly wrinkled and striate longitudinally, and lamellose concentrically.

Dimensions.—Length, 66; height, 60; depth of elevated front, 40 millimetres.

Locality.—Glauconitic limestone, Aldinga Bay.

Subgenus Gryphæa.

Gryphæa tarda, Hutton. Plate vi., figs. 2*a*—2*b*.

Ref.—Hutton in Cat. Tert. Foss. of New Zealand, p. 35, 1873.

Shell rather thin, oblong or irregularly rotund.

Inferior valve tumid very convex, smooth, with broadish folds of growth; free or sessile by a small umbonal area; anterior-ventral margin produced into a conspicuous lobe; umbo subacute, incurved and bent forward; ligamental area broad, moderately excavated medially; muscular impression oblong, situated towards the margin on the produced side. Superior valve flat with an elevated margin, ornamented with imbricating lamellæ.

Dimensions.—Inferior valve, height, 45; breadth, 32; thickness, 23 millimetres.

Localities.—Glauconitic limestones and polyzoal rock, north side of Blanche Point, Aldinga Bay; chalk rock of the Bunda

Cliffs, Great Australian Bight, South Australia (*R. Tate*). Chatham Islands, New Zealand (*Hutton*).

Observations.—Our fossil cannot be mistaken for the recent *G. angulata*, Lamarck, but it bears a close resemblance to the Cretaceous *G. vesicularis*, Lamarck, from which it differs in its more triangular outline, larger lobation, and in the superior valve being lamellose. In my description of the chalk-rock of the cliffs of the Great Australian Bight I have remarked that, "on a cursory inspection one is struck by its similarity to the chalk of England, heightened by the presence of layers of black flints and of fossils with a Cretaceous facies such as *Salenia* (*S. tertiaria*, Tate), *Cidaris* (*C. australasiæ*, Duncan), *Gryphæa* (*G. tarda*, Hutton), like *G. vesicularis*, a *Terebratula* (*T. subcarnea*, Tate) barely distinguishable from *T. carnea*, *Terebratulina*, &c." Trans. Roy. Soc., S. Aust., 1879.

Hitherto *G. tarda* has been found at the Australian localities only in the lowest beds of the marine series of the Older Tertiary. I am not sure if our fossil is correctly named, as I have not had specimens of the New Zealand species for comparison, it answers fairly well to Hutton's diagnosis, except that it is only of about half the size. The original description reads as follows:—Irregularly ovate, umbo of left valve incurved and bent slightly forwards; exterior smooth, with concentric striæ; right valve rather concave, often thickened near the margin, much smaller than the left valve; area broad triangular, distinctly transversely striated; muscular impression suborbicular, rather flattened above where it is deeply sunken, posterior, placed high up; height 2·4, length 1·7 inches.

Genus Dimya, *Rouault.*

The genus *Dimya* was founded for an oyster-like fossil of the Parisian Eocene with a second adductor impression, and by most conchological writers has been placed in the family Ostreidæ, the additional scar being regarded as the homologue of the small anterior scar in *Pecten*. Tyron* seems to have studied a living example of the genus dredged off the Antilles, which he describes as "essentially an oyster having two adductor muscles, the exterior layer of the shell pearly, the inner porcellanous, hinge with a pit like *Hinnites*." He follows Stolickza (in "Cretaceous Pelecypoda of Southern India") in placing the genus in the sub-family Vulsellinæ, family *Aviculidæ*. As the anatomy of *Dimya* agrees with that of *Ostrea*, the original position assigned to the genus in the scheme of classification would thus appear to be the correct one, despite the fact of its dimyarian character.

---

* Systematic Conchology, vol. iii., p. 281, 1884.

The two new species which I refer to *Dimya* have the general aspect of *Plicatula* rather than of *Ostrea;* whilst the two diverging cardinal ridges make an approach to *Placuna*, though functionally different. The internal characters presented by them are as follows:—

Right valve attached, with two diverging cardinal ridges crenulated for the greater portion of their length; cartilage pit triangular, with a raised margin, within the angle formed by the cardinal ridges. Posterior muscular impression large, oval, in about the same position as the single scar in *Plicatula;* the anterior scar is ovate, small but deeply impressed, close under the end of the cardinal ridge; pallial line entire. Left valve free, with two diverging cardinal furrows crenulated within the grooves.

SYNOPSIS OF SPECIES.

Coarsely radially ribbed; internally ribbed.	*D. sigillata.*
Finely radially ribbed; margin only ribbed.	*D. dissimilis.*

Dimya dissimilis, *spec. nov.* Pl. iii., figs. 9*a*—9*c*.

Shell ovate-oblong to ovate-triangular; inequivalve, inequilateral, posteriorly oblique; umbo sub-central, dorsal line usually straight. Right valve attached by varying extent of surface; free part obliquely elevated, slightly convex, ornamented by many high-rounded ribs frequently bifurcating towards the front, crossed by lamellæ which give rise to imbricating scales or spinous scales on the radial ribs. Left valve free, flattish, a little swollen in the umbonal region, depressed centrally, and elevated at the margin; scaly fringed with imbricating lamellæ. Interior of both valves with radial riblets interposed between the pallial line and the shell margin, most conspicuous in the dorsal region.

Dimensions.—Length, 10; height, 13 millimetres.

Localities.—South Australia: Gastropod-bed, near Morgan, and elsewhere in the Middle Murravian, in the raggy limestones at Mannum, on the River Murray; Salem, near Callington, on the R. Bremer; Rolls Point, Nepean Bay, Kangaroo Island. Victoria: Muddy Creek, Hamilton, and Corio Bay, Geelong (*R.T.*)

Dimya sigillata, *spec. nov.* Plate viii., figs. 8*a*—8*b*.

Shell ovate-oblong, inequivalve, subinequilateral, posteriorly somewhat oblique; umbos subcentral, dorsal line usually straight.

Right valve attached by a large surface, free part much elevated, ornamented by numerous rounded radial riblets and a few imbricating lamellæ of growth. Left valve free, slightly concave, except in the umbonal region, included within the

right valve; faintly rayed and concentrically laminated. Interior of both valves with conspicuous radial riblets within the pallial line and terminating there; the denticulations of the cardinal ridges continuing on the lateral margins and gradually developing into riblets.

Dimensions.—Length, 6·5; height, 7·5 millimetres.

Localities. — Turritella clays and glauconite limestones, Aldinga; glauconite sands, Adelaide bore; chalk-rock, Bunda Cliffs of the Great Bight.

D. sigillata differs from *D. dissimilis* in the erect front of the attached valve and finer ornament, and by the radial riblets within the pallial line; in the last particular this species recalls certain *Plicatulæ* of the Cretaceous and Jurassic rocks of Europe. *D. sigillata* approaches externally rather to *Ostrea* than to *Plicatula*, whilst the converse is true of its congener, *D. dissimilis*.

FAMILY ANOMIIDÆ.

Anomia cymbula, *spec. nov.* Plate ix., fig. 5.

Shell obliquely oblong-ovate, somewhat solid, convex, with compressed sides; umbo subcentral, acute, perceptibly elevated, submarginal; surface densely rayed with slender riblets, which are covered with subspinous transverse scales.

Dimensions.—Height, 10; length, 5; depth of valve, 3·5 (nearly) millimetres.

Locality.—Turritella-clays at Blanche Point, Aldinga Bay.

Genus Placunanomia.

SYNOPSIS OF SPECIES.

Valves ornamented with coarse radial threads, subspinose. *P. Ione.*

Valves ornamented with fine radial threads. *P. sella.*

Placunanomia Ione, *Gray.* Pl. v., figs. 7*a*—7*b*.

References.—Proceedings Zoological Society, 1849, p. 123; Hutton, in Cat. Marine Moll. of N.Z., 1873, p. 84.

Superior or left valve irregularly orbicular, usually slightly convex, but varying from flat to very convex, horny-pellucid, surface ornamented with imbricating scaly lamellæ and radial threads or ridges; umbo sub-marginal, depressed, with a slight back curvature. Ligamental scar within the umbonal cavity transverse oblong, circumscribed by a raised border, radially striated, adjacent to the anterior margin of which is a small conspicuous pedal scar.

Dimensions.—Length, 54; height, 47 millimetres.

Localities.—Oyster banks of the Upper Murravian at the North-West Bend, and of the Upper Aldinga series at Aldinga

and Adelaide. Muddy Creek, Hamilton, a few small flat smooth examples (*J. Dennant*).

It is not with confidence that I refer the fossil under review to the recent species inhabiting the waters of the New Zealand and South Australian shores. It exhibits, however, very great variation, especially in respect to the radial ornamentation. Usually the rays are obsolete, except towards the margin. In other examples the rays are moderately strong and numerous, as in recent examples, but occasionally the ribs are thickened, elevated, and raised into sub-spiny scales, the ribs being generally few in number.

Though the attached valve is unknown, despite the fact that several score of the free valves have been collected, yet there cannot be a doubt that it is correctly placed in the genus *Placunanomia*, as the shelly base of the plugs are conspicuous objects on oysters and other molluscous shells associated in the same deposit.

Placunanomia sella, *spec. nov.* **Pl. v., figs. 1*a*—1*c*.**

Shell suborbicular to triangular-ovate, thin, inequivalve, inequilateral; umbos depressed, marginal. Left valve convex from the ventral to the dorsal margin, with lateral areas more or less elevated; right valve concave, with depressed sides, sinus small pyriform. Surface of both valves ornamented with numerous radial threads and lamellæ of growth. In young shells the radii are minutely scabrous; a variable character consists of radial and concentric undulations. Interior of left valve with a submarginal oblique cartilage pit and two oval subcentral muscular impressions; the latter are superimposed, that produced by the muscle of the plug the larger. Interior of right valve with a single adductor impression within the posterior margin of the disc, posterior lobe of notch overlapping on the anterior lobe, and more or less agglutinated therewith; the margin of the notch with a raised border. In adult specimens the marginal border is excessively developed to form a tubular sheath, to which the shelly base of the plug becomes adherent.

Dimensions of a largish specimen.—Length, 43; height, 40 millimetres.

Localities.—South Australia: Abundant in the basal part of the calciferous sandstone of the River Murray cliffs at MacBean's Pound, near Blanchetown; in a well-sinking. "Nine-Mile Camp," near the North-West Bend (*R.T.*)

Tasmania: Table Cape, determined from a left valve received from Mr. R. M. Johnston.

Victoria: A thin, translucent form, with flattish sides, is common at Muddy Creek; a very small example, Schnapper Point, Hobson's Bay (*R.T.*)

New Zealand: Two left valves of an unnamed "Ostrea, No. 175, from Oamaru Creek, Otago," received from the Wellington Museum, are comparable with the triangular-ovate form of *P. sella*. The two subcentral muscular scars so characteristic of the genus are well displayed.

FAMILY PECTINIDÆ.

Genus Pecten.

SYNOPSIS OF SPECIES.

I. Radially ornamented.
  1. Inequivalve, interspaces with shagreen-sculpture.
    Eight radial folds and many riblets. *P. consobrinus.*
    Twelve truncated ribs. *P. subbifrons.*
    Seven broad plications or compressed plicæ. *P. palmipes.*
  2. Inequivalve; no shagreen-sculpture.
    Ribs simple. *P. Murrayanus.*
    Ribs dichotomously divided. *P. dichotomalis.*
  3. Equivalve; radial ribs more or less scaly.
    Ribs 25, flatly rounded, one or two riblets on each flank. *P. antiaustralis.*
    Ribs 25, rounded, broader than interspaces, densely squamose. *P. Eyrei.*
    Ribs 35-40, flatly rounded. *P. Flindersi.*
    Ribs 35-40, acute; one riblet on each flank. *P. Peroni.*
    Ribs 30, flatly rounded equal to the furrows. *P. Sturtianus.*
    Ribs 50, narrow; oblique-linear sculpture in the interspaces. *P. Aldingensis.*
    Ribs 60-70, very narrow. *P. Yahlensis.*
  4. Radially plicate and ribbed with spinose ornament.
    Flat; plicæ 9, intermediate ribs 9. *P. Foulcheri.*
    Inflated; plicæ 7-9, intermediate ribs 7-9. *P. spondyloides.*
  5. Radially plicate and ribbed with scaly ornament.
    Radial folds 7-9, simple. *P. Gambierensis.*
    Radial folds bifurcating; corrugated. *P. polymorphoides*

II. Valves smooth, or nearly so.
  Surface concentrically striated; ears plain. *P. Hochstetteri.*
  Surface faintly rayed; ears rayed. *P. Yahlensis.*

III. Valves with *internal ribs.*
  Valves smooth or concentrically striated, internal ribs 30-36 pairs. *P. lucens.*
  Valves concentrically or reticulatedly striated or ribbed; internal ribs 9. *P. Zitteli.*

Pecten consobrinus, *spec. nov.* Plate iii., fig. 6.

Shell orbicular, fan-shaped, slightly convex, equilateral, subinequivalve, the left valve somewhat flatter. Ornamented with about eight radial folds and numerous (about 100) thickish riblets; the riblets are rigid, unequal in size, and separated by irregular intervals which are minutely granular and usually broader than the riblets.

Right valve with rayed, unequal ears; anterior ear larger, subaliiform, slightly notched on the underside; posterior ear triangular, perpendicularly truncated. Ears of left valve unequal, radially ribbed; the anterior one larger, triangular, outer margin curved; posterior ear triangular, perpendicularly truncated.

Dimensions.—Length and height about 85 millimetres.

Localities.—Oyster banks of the Upper Aldinga series at Aldinga and Hallett's Cove, St. Vincent Gulf.

It is with some hesitation that I separate these shells from *P. bifrons*, but the slight differential characters relied on are observable at all stages of growth; thus left valves of 15 millimetres diameter are distinguished by their three-ridged radial ribs; at 30 millimetres diameter, whilst *P. bifrons* has yet the elevated simple scaly ribs and plain furrows, *P. consobrinus* has almost lost the plicæ which are replaced by four or five threads, and about three occupy the furrows; these divergencies culminate in the very numerous radial threads and obsolete folds of the adult. Similar changes are observable in the other valve. *P. consobrinus* is moreover less inequivalve than *P. bifrons*.

Pecten subbifrons. Tate. Plate iii., fig. 2.

Ref.—Proc. Roy. Soc. S. Australia, vol. iv., p. 44, 1882.

Shell orbicular or triangularly orbicular, fan-shaped, equilateral, slightly inequivalve, umbos depressed.

Right valve slightly convex, rayed with twelve compressed truncated ribs about equalling in width to the deep flatly concave furrows; the ribs carry two or three irregularly granular nodose riblets, and there may be one or two raised lines in the furrows. The surface, save on the riblets, granular-shagreen. Ears rayed, unequal; the interior one much larger, outwardly curved and sinuated below; posterior triangular. Left valve rather flatter than the right, but with similar ornament; ears subequal, obtuse-angled, rayed. Interior of both valves plicated but not ribbed.

Dimensions.—Length and height, 50 millimetres; a smaller specimen, length 28, height 30 millimetres.

Localities.—Oyster beds, Government house quarry, Adelaide *(R.T.)*, Polyzoal-bed, mouth of R. Onkaparinga.

This species, which has the general form and shagreen-sculpture of *P. bifrons*, differs from it chiefly by its compressed truncated and more numerous ribs; the valves are flatter and the ears, particularly of the right valve, differ somewhat.

Pecten palmipes, *spec. nov.* Plate v., fig. 4. Plate vii., figs. 4*a*—4*b*.

Shell triangularly orbicular, inequilateral by projection of posterior part; slightly inequivalve, the right valve a little more convex than the left; ears large subequal, umbos depressed. *Right valve* rayed with seven broad rounded plications, gradually becoming broader and flatter as they approach the margin; the interstitial spaces are narrow and deep. The whole surface rayed with numerous linear ridges, the interspaces minutely granulated. Posterior ear triangular, obliquely truncated, rayed; anterior ear, larger, projecting, outer margin curved, indented on the under side, radially ridged. *Left valve* more depressed in the umbonal region, rayed with six compressed elevated plicæ, the flatly rounded surfaces of which are bordered by two furrows, increasing in number towards the front; the interstitial spaces between the plicæ are very broad and deeply concave, bearing riblets in old shells towards the margin. Spaces between the riblets minutely granulated. Ears triangular obliquely or perpendicularly truncated, radially ridged, subequal, the anterior one larger.

Dimensions of largest specimen.—Length 71, height 71, thickness through both valves 27 millimetres.

Localities.—Edithburgh, Yorke Peninsula; oyster banks, Aldinga Bay.

This species has the general characters of the recent South Australian *P. bifrons*, of Lamarck, possessing also its peculiar granular shagreen-sculpture; but it differs by the obliquity of its valves, in being higher than long, and in the form of its radial plicæ; the interior is plicated but not ribbed as in the living species.

Pecten Murrayanus, *spec. nov.* Plate vii., figs. 5*a*—5*b*.

Shell orbicular, fan-shaped, somewhat thin, scarcely equilateral, projecting slightly in front, inequivalve; valves rayed with about 20 rounded ribs broader or equal in breadth to the concave furrows, the whole crossed by close-set, thin, erect lamellæ coincident with the margin; the lamellæ increase in denseness from the umbo forward. Interior with flat ribs corresponding with the exterior furrows.

Left valve slightly and regularly convex; umbo acute, not extended beyond hinge line. Ears unequal, the anterior large roundly truncate, finely striated, perpendicularly and faintly rayed; the posterior elongate, arcuate, prominently rayed and concentrically striated.

Right valve nearly flat, depressed at the umbo; ears equal truncate, finely striated perpendicularly, faintly rayed.

Dimensions.—Length, 47; height, 45; thickness through both valves, 10 millimetres.

Localities.—Common in the calciferous sandstone of the Middle Murravian, Blanchetown, &c.; rare in the Lower Murravian at Mannum. Not uncommon at Muddy Creek, Hamilton.

This species belongs to a small group represented by *P. solaris*, Born, but it is not identical with any of the living species monographed by Reeve. *P. solarium*, Lamk., a fossil species of the European Tertiary, is also of the same type, but *P. Murrayanus* is distinguished by its fewer ribs and smaller wings.

P. leopardus, Reeve, is its nearest ally, but the ribs are fewer, separated by wide interspaces, and is scarcely equivalve.

Pecten dichotomalis, *spec. nov.* Plate ix., figs 3*a*—3*c*.

Shell suborbicular, fan-shaped, thin, equilateral, inequivalve, umbos depressed. Right valve regularly slightly convex, with about nine broad radial undulose folds, whole surface ornamented with flat riblets narrower than the interspaces which are crossed by raised threads about half the width of the alternating grooves. The riblets increase in number to more than 100 by two successive bifurcations at irregular intervals, and towards the margin are covered with minute imbricating scales; front margin undulate and minutely crenulated. Ears unequal, dorsal line distantly serrately fringed; anterior ear slightly sinuated on the underside, with five to six radial ridges covered with small triangular serratures; posterior ear triangular, slightly obtuse-angled, with seven to eight serrated ridges. Left valve flat, with the radial folds angular, the riblets stouter and less numerous, the anterior one-fourth of the surface densely covered with conspicuously large, erect scales. Ears large, equal; radial ridges about three on which are a few scattered, erect, triangular scales.

Dimensions.—Length, 32; height, 30; thickness through both valves, 4·5 millimetres.

Locality.—Schnapper Point, Hobson's Bay (*R. T.*).

Pecten antiaustralis, *spec. nov.* Pl. ix., figs. 7*a*—7*c*.

Synonym.—P. asperrimus, var. *Tate.* Trans. Roy. Soc., S. Aust., vol. iv., p. 34, 1882.

Shell sub-orbicular, moderately convex sub-equivalve, the right valve less convex, sub-æquilateral, rayed with about 25 ribs which are flanked by one or two smaller ribs on each; the ribs and riblets are convex, crossed by erect lamellæ, the

interstitial furrows flattish, arcuately striated. Ears unequal large, radially ridged and transversely lamellate-scaly; right-posterior, triangular, obliquely truncated, anterior produced, sinuated ventrally; left-posterior similar to corresponding one in right valve, anterior larger, obtuse angled.

Dimensions of a large individual.—Length and height, 58; thickness through both valves, 25 millimetres.

Localities. — Oyster beds in the uppermost strata at Adelaide, Hallett's Cove, and Aldinga Bay; Edithburg and Stansbury, Yorke Peninsula (*R.T.*).

This species is very closely allied to *P. australis*, Sow., which is probably identical with *P. asperrimus*, Lamarck, but as my comparisons have been made with what is certainly the former, my remarks have reference only to it. The chief differences observable are the *lamelliform* ornamentation of the convex ribs and riblets, whilst in *P. australis* they are angular, and beset with distant scaly serratures or spinous scales; moreover the valves, especially the left valve, is more convex.

The young of the two species are much alike, having simple ribs, developing with age a riblet on each side. Rarely does *P. australis* acquire more, but *P. antiaustralis* does so as a rule, and aged examples exhibit two or three on each flank, and often one in the furrow, whilst the concentric lamellæ are continuous across the furrows.

The ears of the fossil species are larger, and the shell attains to greater dimensions.

P. antiaustralis, however, exhibits variations in the degree of convexity of the valves and ribs, whilst *P. australis*—the commonest shell on the S. Australian coast—is true to its type; nevertheless, it is easy to separate the species.

P. actinoides, Sowerby, of the Chilian Tertiary, is apparently a near ally.

Pecten Eyrei, *spec. nov.* Pl. viii., figs. 3*a*—3*b*, 6.

Shell ovate orbicular, scarcely equilateral, sub-inequivalve, slightly convex, ornamented with about 25 rounded ribs as broad or broader than the smooth interspaces; ribs with close-set erect crescentric scales; occasionally a riblet is interposed between the primary ribs towards the front. Ears unequal, radially ridged, and transversely lamellated; of the right valve, the posterior ear triangular, obliquely truncate; anterior ear elongated with a deep byssal sinus; of the left valve, the anterior larger than the posterior with the outer margin curved, the anterior one perpendicularly truncated.

Dimensions.—Length, 45; height, 48; thickness through both valves, 12.

Localities.—Chalk rock of the Bunda Cliffs, Great Australian Bight; Polyzoal rock, Aldinga Bay; at mouth of the River Onkaparinga; and at Surveyor's Point, Yorke Peninsula (*R.T.*).

The species may appropriately be named in honour of Sir John Eyre, from the circumstance of its occurrence at Wilson Bluff, Great Australian Bight, whose graphic description of an attempt to scale this bold headland must be familiar to those who have read the narrative of his adventurous overland journey to Perth.

Pecten Flindersi, *spec. nov.* Plate viii., fig. 7.

Shell obovate to triangular, orbicular, equilateral, or slightly inequilateral, equivalve moderately convex, umbos depressed, acute, ornamented with from 35 to 40 flatly rounded ribs with broader interspaces. The ribs are smooth or surmounted by distant minute scales; the interspaces are marked with perpendicular engraved lines.

Ears as in *P. Eyrei.*

Dimensions.—Millimetres.

Length.	Height.	Thickness.	No. ribs.
54	56	23	35
51	54	—	40
43	50	—	30
35	37	11	37
77	80	38	40
60	—	15	50

Localities.—Glauconite limestone, Aldinga Bay; glauconite sands, Adelaide bore; clays at Muloowurtie, Yorke Peninsula.

P. Flindersi has a general resemblance to *P. rudis*, G. B. Sowerby in Darwin's Geol. Observ., of the Chilian Tertiary, but that shell has fewer ribs with narrower interspaces.

Species-name in commemoration of Captain Flinders, the intrepid Australian navigator.

Pecten Peroni, *spec. nov.* Plate x., figs. 1*a*—1*b*.

Shell ovate-orbicular, equilateral, equivalve, nearly flat, umbos acute, depressed, ornamented with numerous acute or subacute scaly ribs flanked on each side by a scaly riblet; interspaces very shallow, a little wider than the ribs, minutely granular. The primary ribs vary from about 35 to 40, and with the riblets are covered by crescentic scales or short triangular spines. Ears as in *P. Eyrei*, but the posterior ones with the dorsal margin usually serrately fringed.

Dimensions.—Length, 39; height, 42; thickness through both valves, 11 millimetres.

Localities.—Polyzoal limestone, Aldinga Bay; Adelaide bore.

This species is more depressed, equilateral, and has more ribs than *P. antiaustralis* and *P. australis*, whilst the anterior ear of the left valve is not winged.

This species is dedicated to the memory of M. Peron, the naturalist to the Baudin Expedition, as a mark of my appreciation of his geological observations on Kangaroo Island.

Remarks on the affinities of the three foregoing species :—

They agree in one particular, which distinguishes them from *P. australis* and *P. antiaustralis*, namely, that the anterior ear of the left valve is not winged.

The oldest species in time is *P. Flindersi*, which is depressed, and ornamented with numerous, narrow, rounded ribs, smooth or distantly scaly; in *P. Eyrei* the ribs are fewer in number, broad, and densely scaly; whilst *P. Peroni*, which occupies an intermediate geological position, has the numerous narrow, but acute ribs of the former, and the dense scaly ornament of the latter, diverging, however to the spinous scales of *P. australis*.

Pecten Sturtianus, *spec. nov.* Plate vii., figs. 2*a*—2*c*.

Shell nearly orbicular, convex, equivalve, equilateral; about 30 flatly rounded radial ribs covered with distant, thick, imbricating scales, the alternating furrows about as broad as the ribs, marked with transverse or oblique lines. Margin of valves crenulate-undulate. Right valve with unequal ears; the posterior larger, triangular, and subaliiform, strongly rayed and granular or spinosely scaly; the anterior ear triangular, faintly three-rayed, with perpendicular lamellæ conspicuous only towards dorsal margins, and obliquely striated, Left valve, posterior ear elongately produced, narrow, deeply excavated by a byssal sinus, four nodular-scaly ribs; anterior small, similarly ornamented to corresponding ear in the right valve.

Dimensions. — Length, 18; height, 18·5; and thickness through both valves, 10 millimetres.

Localities.—Not uncommon in the Calciferous sandstones of the R. Murray cliffs at Blanchetown, &c.; raggy limestones at Mannum (*R. T.*); rare Muddy Creek, Hamilton.

The species is dedicated to the memory of Captain Sturt, the pioneer geologist of the basin of the Lower Murray river.

P. Sturtianus has a general resemblance to *P. Malvinæ*, of the Viennese Miocene.

Pecten Aldingensis, *spec. nov.* Pl. vii., figs. 1*a*—1*c*.

Shell orbicular, or a little longer than high, thin, subequilateral, inequilateral. Right valve moderately convex, left valve flatter, ears unequal; both valves ornamented with

about 50 narrow, rounded, sub-depressed ribs, straight or slightly flexuous, with narrower interspaces, which are sculptured with oblique linear sulci and punctures; towards the front margin a few indistinct concentric lamellæ cross the ribs.

Right valve with the ears very unequal, the anterior aliiform, radially and concentrically scaly-striated, ventral margin sinuated for the passage of a byssus; posterior ear triangular, vertically and radially scaly-striated.

Left valve with unequal ears, the posterior one the smaller; both triangular, and radially costated and scaly.

Dimensions.—Length and height, 32 millimetres.

Locality.—Glauconitic limestone, Aldinga Bay.

Pecten Yahlensis, *Tenison-Woods.*

References.—Phil. Soc., Adelaide, 1865, t. 1, fig. 4; *P. Yahlensis*, var. *semilævis*, McCoy, Prodr. Pal. of Victoria, Decade iv., t. 34.

Shell sub-orbicular, thin, equilateral; valves unequal, and with dissimilar sculpture.

Right valve deeper than the left, moderately convex, polished; surface radiated with numerous (60-70) sub-equal, nearly straight, narrow, flatly-rounded ridges, separated by shallow concavities, rather less than the width of the ridges, crossed by distant concentric lines of growth. Ears, with the posterior one a little larger than the anterior; both slightly obtuse-angled, radially ridged, and marked with concentric lines of growth, which rise on the dorsal margin as projecting angular scales; anterior ear slightly sinuated anteriorly for passage of byssus.

Left valve nearly flat, surface radiated with nearly straight, narrow, rounded ridges, about one-third of their width apart, crossed by sharp, erect, crowded, concentric lamellæ. Ears about equal, slightly obtuse-angled, radially ridged, crossed by concentric lamellæ, which form a serrated fringe on the dorsal margin.

In the *var. sublævis* the right valve is quite smooth, whilst another variety has the rostral portion smooth, and the marginal portion radiately ridged.

Dimensions of average sized specimens.—Length and height, about 55 millimetres; but specimens are known from four to five inches in diameter.

Localities.—South Australia: Mount Gambier limestone (*Tenison-Woods*); raggy limestones at Mannum, R. Murray (*R.T.*)

Victoria: Muddy Creek (*R.T.*); Mordialloc; Corio Bay; Bairnsdale; Schnapper Point, Hobson's Bay; near mouth of Sherbrook River (*McCoy*).

"This fossil resembles the well-known German Miocene Tertiary species, the *Pecten Hofmanni* of Goldfuss, so nearly that at first sight one might mistake one for the other; the ridges, however, are slightly larger, usually more nearly equal and less rigid in this species, which is totally distinguished by having the right or deeper valve different from the other, while they are both alike in the *P. Hofmanni*" (*McCoy, op. cit.*).

Pecten Foulcheri, Tenison Woods.

Pecten sp., Sturt. Two Exped., &c., tab. 3., fig. 14.

Pecten sp., Tenison Woods, Geol. Observ., p. 74 (1862).

P. Foulcheri, Tenison Woods, Proc. Phil. Soc. Adelaide, 1865, tab. 1, fig. 3.

Shell thin, equivalve, inequilateral by projection of the front; valves flatly convex with about nine radial angular plicæ on which are scattered towards the front spinous imbrications passing to squamose imbrications on the umbonal region, the concave furrows and sides of plicæ with about nine raised lines, squamosely imbricate especially towards the umbo, the whole crossed by fine concentric striæ.

Ears very unequal; the left anterior moderately large triangular ornamented with three to four rays, squamosely imbricated towards proximal end, and concentric striæ. Left posterior large aliiform with a deep byssal sinus, ornamented with five or six squamosely-imbricate rays. Right anterior as left anterior. Right posterior much larger, subaliiform with several scaly rays.

Dimensions of an averaged specimen.—Length 33, thickness 34, thicknes through both valves millimetres. A large specimen measures 41 by 43 millimetres.

Localities.—Somewhat common in the Mount Gambier limestone *(Tenison Woods)*; very abundant in the Calciferous sandstone of the River Murray Cliffs *(R. Tate)*; Table Cape, Tasmania *(R. M. Johnston!)*; rare Muddy Creek.

Tenison Woods' illustration of this species is a good representation of the common form, around which may be grouped several varieties; whilst individual variations have been developed to such extremes that it would be justifiable to establish three or four species out of them if the connecting variations were awanting.

In the typical form the spinous-processes on the plicæ are slender and distant, occasional examples show crowded large imbricating squamæ and the ornament on the interstitial ridges equally gross. Again the plicæ are broad and convex; in others the flanking ridges to the plicæ acquire the magnitude of the central ridge, this state is usually accompanied by almost obliteration of the furrows and the substitution of scales for spines.

The plicæ only are usually continued as smooth angular ridges on the umbonal portion, the whole surface of which is delicately shagreen-sculptured. In some examples the shagreen-markings cover the whole shell, whilst in others the plicæ and raised lines maintain their scaly ornament to the umbo.

Pecten spondyloides, *Tate.* Pl. iv., figs. 6 and 7.

Reference.—Proc. Roy. Soc., S. Australia, vol. iv., p. 44, 1882.

Shell equivalve, equilateral, about as long as high, inflated, covered with numerous spiniferous ribs. There are usually seven or nine primary ribs, two or three secondaries, and a variable number of tertiaries between each pair of primary ribs, all similarly ornamented. Front margin of valves curved, slightly crenulated, not at all angular. Ears equal, of moderate size, triangular, outer margin perpendicular; there is no byssal sinus.

Variety.—Pl. IV., fig. 7. With the prickly scales of the interstitial ribs reduced to spine-like serratures, and the spines on the primary ribs slender and distant; regular concentric striæ mark the whole surface.

Dimensions of the figured specimen.—Length and height, 44; thickness through both valves, 34 millimetres. A large perfect specimen measures 90 mills. in diameter, whilst fragments indicate a greater magnitude.

Localities.—Oyster banks of the Upper Aldinga series at Aldinga Bay, Hallett's Cove, and Adelaide. The *variety* in the raggy limestones at Mannum.

This very handsome shell has much the appearance of a *Spondylus*, hence its trivial name, and more particularly of *S. imperialis*, of the Chinese Seas; however, it is a Pecten, having an edentulous hinge; moreover, the regular curved umbos of both valves presented by shells of all ages are characters not belonging to *Spondylus*.

Pecten Gambierensis, *Tenison-Woods.*

Reference.—Proc. Phil. Soc., Adelaide, 1865, pl. i., fig. 2.

Shell thick, inequivalve, the left valve regularly convex, the right flatter; inequilateral by projection of the anterior area, ornamented with from five to seven radial folds, which together with the interspaces are covered with imbricating, granular, close-set ribs, the sulci between the ribs regularly transversely striated. Ears unequal, the anterior one small, truncated; the posterior larger, rounded, and strongly ribbed.

Dimensions.—Length and height, about 30 millimetres.

Localities.—Coralline limestone at Mount Gambier and Mosquito Plains (*T. Woods, R.T.*).

The ornament varies in the closeness and stoutness of the radial ribs and their granulations, whilst the plicæ are some

times almost obsolete. The species differs from *P. polymorphoides* in its fewer ribs, never bifurcating or presenting intercostal ribs towards the front margin, and by the regular convexity of its valves.

Pecten polymorphoides, *Zittel.* Plate viii., fig. 2.

Reference.—Pal. von Neu-Seeland, p. 51, t. xi., fig. 3, 1864.

Synonyms.—*Pecten incertus* (*Tenison-Woods*), Proc. Phil. Soc., Adelaide, 1865, tab. i., fig. 1. *P. coarctatus* (*Sturt*), Two Exped., vol. II., t. iii, f. 13; id. *Ten.-Woods*, in Geol. Obs., p. 74, fig.

Shell triangularly orbicular, inequivalve, very inequilateral, projecting anteriorly; convex, inflexed in front; umbonal part irregularly rudely tumulous, rayed with five to seven rather broad ribs; ribs and sulci longitudinally ridged. The ridges, which are covered with imbricating scales, increase in number by bifurcation towards the front, and are there grouped more or less in pairs; interstices between ridges concave, regularly transversely striated; front edge of valve crenulate-dentate. Ears of left valve very unequal; the anterior one is of moderate size, abruptly truncated, with a few scaly rays; the posterior one is elongated, with four stout, coarsely scaly rays; byssal sinus narrow and deep; adductor scar narrow, placed high up on the anterior area.

Dimensions.—Length, 44; height, 40; thickness through both valves, 16 millimetres.

Localities.—Middle Murravian, near Morgan, Blanchetown, and Mannum; Muddy Creek, Hamilton (*R. T.*). Also in the Oamaru series, New Zealand.

P. polymorphoides exhibits some variability in respect to the development of the radial ridges and the corrugations in the umbonal region, and to the extent of the inflexion of the front. Young specimens are nearly equilateral; Zittel's figure represents the species at an early stage of growth, and in which the radial ridges and the ventral inflexion are pronounced; his description does not well apply to the adult shell in respect to the subsmooth or obsoletely striated plicæ, and the auricles as figured by him are not exact. Tenison-Woods' figure of his *P. incertus* represents an averaged-sized specimen, but without corrugations. A specimen of *P. polymorphoides* of about 25 millimetres, sent to me by Professor Hutton, removes any doubt as to the specific identity of the two shells. *P. Burnetti* (Zittel) is a closely-related species.

Among living congeners, *P. polymorphoides* is related to *P. convexus*, Quoy and Gaimard (*P. roseopunctatus*, Reeve, and *P. vellicatus*, Hutton), but its more numerous scaly and slender ridges and the umbonal corrugations distinguish it; and

according to Zittel it is allied to the Mediterranean *P. polymorphus*, Br., but I have no specimens of that species for comparison.

Sturt has given a very good figure of a small example of this species, identifying it with the European *P. coarctatus*; Tenison-Woods reproduces Sturt's figure on p. 76 of his "Geol. Observations," and in his "Introduction to the Tertiary Rocks of South Australia," Phil. Soc., Adelaide, May, 1865, refers Sturt's shell to *P. Gambierensis*. From this association I dissent, as Sturt's figure well shows the umbonal corrugation and inflexed front so characteristic of *P. incertus*, and moreover *P. Gambierensis* does not occur in the Murray cliffs, whilst *P. incertus* is not a rare shell.

Pecten Hochstetteri, Zittel.

Reference.—P. Hochstetterri, *Zittel*, in Palæontologie von Neu-Seeland, p. 50, t. xi., figs. 5*a* and 5*c* (non 5b), 1864; and *Hutton* in Cat. Tertiary Fossils of New Zealand, p. 30, 1873.

Synonym.—Pecten pleuronectes, *Tenison-Woods*, in Proc. Phil. Soc., Adelaide, 1865, pl. i., fig. 5 (non Gmelin).

Shell nearly orbicular, equivalve, equilateral, thin, compressed; both valves smooth, but when slightly weathered showing fine concentric striæ. Ears of right valve subequal, roundly truncated, transversely striated, the anterior one slightly sinuatedly striated. Ears of left valve equal, obliquely truncated, transversely striated. Interior of valves without ribs.

Dimensions.—Longitudinal diameter 58, transverse diameter 60 millimetres.

Localities.—White coralline limestone at Mount Gambier; raggy limestones at Mannum, River Murray; the glauconite limestone, Aldinga Bay; glauconite clayey sands, Adelaide bore; yellow clayey sands, Moolowurtie, Yorke Peninsula; Oamaru formation of New Zealand from several localities.

Having specimens of *P. Hochstetteri* from New Zealand, I can with certainty announce the fact of this species occurring in the Older Tertiary rocks of South Australia.

Zittel describes the right valve as radially ribbed, which is represented by his fig. 5*b*; but specimens agreeing with his fig. 5*a* have been obtained with the valves in opposition, both of which are smooth. Hutton amends Zittel's diagnosis, excluding fig. 5*b*, which belongs to another species, apparently *P. Yahlensis*, Tenison-Woods.

P. Hochstetteri has an external resemblance to the species of the Pleuronectes group, but it is devoid of internal ribs, and is equivalve. This type is well represented in the European Jurassic rocks, indeed our species very much resembles

P. lunularis, Röm., of the Lias. It is highly probable that Tenison-Woods confounded this species with *P. pleuronectes* in his record of the occurrence of the recent species in the Mount Gambier limestone, as the only smooth pecten known to me to be found there is *P. Hochstetteri*.

Pecten lucens, *spec. nov.*

Shell nearly orbicular, slightly inequivalve, equilateral, a little gaping at each side below the ears, compressed, thin, pellucid, externally smooth but radially and concentrically striated under the lense; internally rayed with from 30 to 36 pairs of ribs. Right valve slightly convex from the umbo to the anterior margin; ears equal, straight, truncated, transversely striated and faintly radially ridged. Left valve depressed in the umbonal region; ears obliquely truncated, transversely striated, upper margin sometimes dentate; hinge area internally thickened, bearing at each anterior corner a subacute boss.

Dimensions.—Transverse and longitudinal diameters 48 millimetres; thickness through both valves 10 millimetres. My largest specimen measures 100 millimetres in the diameters.

Localities.—Oyster bed, Aldinga Bay; calciferous sandstone of the River Murray Cliffs at Blanchetown.

P. lucens differs from all living species of the group by the greater number of the internal radial ridges, and by the same character it is separable from the Chilian fossil species, *P. Darwinianus*, D'Orb., to which it bears a close resemblance.

Pecten Zitteli, *Hutton.* Pl. vii., figs. 3*a*—3*c*.

Reference.—Catalogue Tertiary Mollusca of New Zealand, p. 32, No. 118 (1873).

Synonym.—Pecten sp., *Zittel* in Palæontologie von Neu-Seeland, p. 53, t. 9, figs. 1*b* and 3, 1864.

Amusium Atkinsoni, *R. M. Johnston*, in Proc. Roy. Soc., Tasmania, 1880, p. 41.

Shell small, sub-orbicular, compressed, equilateral, equivalve. Interior of both valves concave, shining, with nine or eleven ribs which terminate truncatedly near the margin. Right valve reticulatedly striated or ridged; left valve concentrically striated; ears unequal. The exterior ornament of the right valve varies very much in respect of the number and thickness of the radial and concentric threads; usually the radial threads are stouter than the raised concentric lines, but this form merges on the one hand into a fenestrated ornament, and on the other to one in which the radial ridges are very prominent and minutely scaly. Ears of right valve unequal, the posterior larger and triangular, cancellate; anterior triangular, with concentric scaly lamellæ.

The left valve is invariably concentrically striated, the interior ribs showing as faint dark lines, but may present a smoothed surface from exfoliation of the external shell layer. Ears very unequal, posterior the larger, aliiform, distantly arcuate-ridged and faintly rayed; anterior triangular, concentrically striated.

Dimensions of a large specimen.—Length, 10; height, 9·5 millimetres.

Localities.—Abundant in the Turritella-marls, Aldinga Bay; glauconitic sands, Adelaide bore; Muddy Creek, Vict.; gastropod bed, R. Murray cliffs.

Table Cape, Tasmania (*R. M. Johnston!*).

Several stations of the Ototara Group, New Zealand (*Hutton, op. cit.*).

Zittel's figures represent the interior with ten ribs; Hutton, however, describes the interior with eleven ribs, and the exterior as smooth. Nevertheless, two impressions of right valves from Waihao River in my possession, received from the Wellington Museum, show distinct traces of a fenestrated ornament between eleven radial lines indicating the internal ribs. I think it is clear that Hutton's diagnosis is based upon an excorticated specimen of a left valve, and that the Waihao River specimens here referred to supply the desiderated characters necessary to establish specific identity between the very perfect Australian specimens and those on which *P. Zitteli* has been founded.

In respect to *P. Atkinsoni*, Johnston, a left valve of which in my possession, kindly communicated by the describer, is in every respect identical with Australian specimens, I am inclined to the opinion that the dissimilar ornament of the right valve has escaped his notice, and I have little hesitation in referring it to *P. Zitteli*.

It is only at Aldinga and Adelaide that are found examples of large dimensions equalling those of the New Zealand ones. The Table Cape and Muddy Creek specimens are usually less than half the size.

P. Zitteli recalls *P. personatus*, Zieten, of the Lower Jurassic rocks of Europe; the Tertiary, *P. pygmæus*, Munster, seems to belong to the same type, which is unrepresented in living creation.

Hinnites Corioensis, *McCoy.*

Ref.—Prodromus Palæontology of Victoria. Decade VI., pl. lviii.; 1879.

Localities.—Victoria—Extremely common at Corio Bay; near Bairnsdale, on the Nicholson River (*McCoy*). South Australia—Glauconitic limestone of Aldinga Bay.

SYNOPSIS OF THE SPECIES OF THE

SUB-FAMILY LIMINÆ.

GENUS LIMA.

Radial ornament simple.	
Obliquely ovate, 25 to 30 ribs.	*L. Bassii.*
Ovate-trigonal, 70 ribs.	*L. polyactina.*
Radical ornament divaricate.	*L. linguliformis.*

SECTION LIMATULA.

Radial ribs prominent.	*L. Jeffreysiana.*
Radial striæ very numerous.	*L. polynema.*

GENUS LIMEA.

Ribs many, obtuse, interspaces cancellated.	*L. transenna.*
Ribs 14, interspaces striated transversely.	*L. alticostata.*

Lima Bassii, *Tenison-Woods.* Plate v., fig. 8; plate viii., fig. 1.

Reference.—Proc. Roy. Soc., Tasmania, for 1876, p. 112 (1877).

Shell obliquely subovate, somewhat compressed, rather solid, rayed with from 25 to 30 imbricately squamose ribs; margin full and equally rounded with a prolonged curve, post-dorsal side short and very slightly concave, almost margined through its whole extent by a small obtuse-angled auricle, which is radiately and squamosely ribbed; anterior side, with an obsolete auricle, truncated with a straight sloping line; lunule rayed with granular ribs. Umbos acute, and only slightly arched. Hinge line narrow, lateral margins of hinge area with a small denticle. The ribs vary much in number, irrespective of size of shell, as few as 21 and as many as 34 have been counted; they are usually flatly rounded with narrower interspaces, but specimens from the River Murray cliffs have subangular ribs; the interspaces are transversely striated or lamellate, or, as in the case of examples from the Lower Aldinga series, obliquely sculptured.

Dimensions of figured specimens.—Pl. 5., fig. 8, dorso-ventral diameter 31·5, lateral diameter 27, thickness through both valves 5 millimetres; pl. 8., fig. 1, the respective values are 30, 26, and 5. Diameters of largest specimen 41 and 33.

Localities.—Type-form with rounded ribs and transverse sculpture between. Table Cape (*R. M. Johnston!*); Muddy Creek (*R.T.*).

Var. a with subangular and transverse lamellæ between. Middle Murravian series near Morgan and Blanchetown (*R.T.*).

Var. b with flatly rounded ribs and oblique sculpture between. Glauconitic limestone, Aldinga Bay; glauconitic sands, Adelaide-bore (*R.T.*).

L. Bassii so closely approximates to *L. squamosa*, or the so-

named species of Australian seas, that it is with some hesitation I venture to separate them. However, *L. Bassii* may be distinguished by its flatter shell, less inflated beaks, less produced anteriorly, and by its narrower hinge line, whilst the ribs are usually more rounded and the anterior ear obsolete.

Taking two examples of about the same size, the following measurements will formulate some of the above-mentioned differences :—

	L. Bassii	*L. squamosa*
Antero-dorsal diameter ...	41	39 millimetres
Lateral diameter	33	35 "
Breadth of hinge... ...	10	13 "

The New Zealand Older Tertiary species, *L. multiradiata* and *L. paleata*, Hutton, are closely related to *L. Bassii*, but in them the ribs are wider apart.

Lima polyactina, *spec. nov.* Pl. viii., figs. 4*a*—4*c*.

Shell minute, ovate-trigonal, ventricose, nearly equilateral; lateral and ventral margins regularly convex, attenuated towards the dorsal line, ornamented with numerous (about 70) depressed radial ribs, smooth or minutely-scaly, interstices narrower than the ribs, punctatedly impressed. Hinge line very short, almost wholly anterior; umbos erect, acute, divergent; lunule-area deeply impressed; anterior auricle minute, triangular, posterior obsolete.

Dimensions.—Ventro-dorsal diameter, 4; lateral diameter, 6 millimetres.

Locality.—Adelaide bore, three examples (*R.T.*).

Lima linguliformis, *spec. nov.* Pl. iii., figs. 1*a*—1*b*.

Shell oval, sub-compressed, equivalve, almost equilateral; valves gaping in front, ornamented with flattened, slightly wavy, inconspicuous ribs which radiate from the longitudinal centre-line; ribs obscurely granose-nodulose towards the ventral margin, the narrow interstitial furrows coarsely punctated. Anterior auricle, with the outer margin thickened and everted; posterior auricle obsolete.

Dimensions.—Ventro-dorsal diameter, 19; lateral diameter, 15; thickness through both valves, 6 millimetres.

Locality.—Muddy Creek (*R.T.*); Schnapper Point, Port Phillip Bay (*R.T.*).

This fossil species is allied to *L. scabra*, Born., and *L. tenera*, Chem., by its divaricate sculpture, and approaches the latter in shape, but differs in its oval outline and imperfect posterior auricle.

Lima Jeffreysiana, *Tate.* **Pl. iv., fig. 8.**

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

Synonym.—*Lima subauriculata*, Tenison-Woods, Proc. Roy. Soc., Tasm., for 1876, p. 113 (1877), (*non Montfort*).

Shell thin, elongate-ovate, with nearly straight sides, subequilateral by the slight obliquity of the hinge line, ventricose. Surface ornamented with distant, acute, longitudinal ribs and close-set, undulate, concentric striæ; the rays are very conspicuous on the middle and anterior parts, but become indistinct towards the posterior border; the intercrossing of the medial ribs and the concentric striæ form blunt imbricating serratures; the concentric striæ merge into strong folds towards the anterior border. Auricles of moderate size, equal, sharply angular. Umbos elevately and acutely produced.

Dimensions.—Length, 23; breadth, 15; thickness, 16 mills.

Localities.—Table Cape (*R. M. Johnston !*); Yorke Peninsula, Aldinga, River Murray Cliffs, Mount Gambier; Muddy Creek and Schnapper Point, Hobson's Bay (*R. Tate*).

L. subauriculata and *L. elliptica* differ from *L. Jeffreysiana* by their ribs, smooth sides, medial furrows, and more inflated umbos. Among recent Australian shells the fossil species approaches *L. Strangei*, from which it differs by its straighter sides, by its more numerous and acute ribs, and by being more ventricose.

Species dedicated to Mr. Gwyn Jeffreys, F.R.S., the eminent conchologist, in acknowledgment of his help in its elaboration.

Lima polynema, *spec. nov.* **Plate x., fig. 9.**

Shell thin, ventricose, obliquely ovate; surface marked with very fine, numerous (about 90) radial threads and a few distant concentric striæ.

Dimensions. — Ventro-dorsal diameter, about 10; lateral diameter, about 7 millimetres.

Locality.—Glauconitic sands, Adelaide bore.

An imperfect specimen only known, but is distinguishable among recent and Tertiary species by its numerous simple radial threads and nearly straight sides.

Limea transenna, *spec. nov.* **Plate ix., figs. 6*a*—6*b*.**

Syn.—? *Cucullæa minuta*, Johnston, Proc. Roy. Soc., Tasmania, for 1879, p. 40 (1880).

Shell small, thin, obliquely subtrigonal; ventricose, attenuated in the dorsal region, expanded towards the ventral margin, which is posteriorly obliquely produced. Umbos elevately acutely produced. Valves closed, rayed with numerous obtuse ribs, the interstitial spaces broader, granulated in the middle line, and cancellated by equidistant concentric striæ

interrupted by the radii. Auricles small, angular; hinge line narrow, with four or five longitudinal plications on each margin. Inner margin of valves crenulated.

Dimensions.—Ventro-dorsal diameter, 8·5; lateral diameter, 6; thickness through both valves, 5.

Localities.—Muddy Creek, Hamilton; Mount Gambier, white polyzoal limestone (*R. T.*). Probably this species at Table Cape, Tasmania.

In this species the denticulations of the hinge are longitudinal and marginal; whilst in *L. alticosta* they are transverse, and occupy the whole length of the hinge-line.

Mr. R. M. Johnston has described a shell under the name of *Cucullæa minuta*, op. cit., which from its description may be either *Limea transenna*, or conspecific therewith. He moreover states that it is not unlike *Limatula subauriculata* [*L. Jeffreysiana*] in general appearance. I transcribe its diagnosis:—"Shell very minute, thin, obliquely oval; hinge-line straight, narrow, with three or four teeth, oblique at extreme corners; surface of valves ornamented with fine radial ridges, and crossed by lines of growth; towards the margin the ridges are lamellar, and are also imbricated where intersected by the concentric lines of growth; margin finely crenulate; long. 3 mil., lat. $2\frac{1}{2}$ mil., thickness at umbo of both valves $1\frac{1}{2}$ mil. Rare, Table Cape."

Limea alticosta, *spec. nov.* Plate iii., fig. 8.

Shell minute, shortly oval, slightly inequilateral, dorsal line short, straight; umbo central, elevated, obtusely produced; auricles small, unequal. Rayed with 14 elevated subacute ribs, narrower than the interspaces, faintly striated transversely. Hinge margin with from six to seven transverse denticles on each side of the ligamental socket. Ventral margin strongly crenate.

Dimensions.—Length and height exceeding two millimetres.

Locality.—Adelaide bore (one ex.).

This species resembles the type of the genus, *L. Sarsii*, but is more inequilateral and has plain ribs; its similarity to *L. acuticosta*, Munster, of the European Lias is very striking, from which it differs externally by its less oblique shape, whilst the hinge teeth of that species are longitudinal on the outer margins, and not transverse throughout the cardinal line.

FAMILY SPONDYLIIDÆ.

Genus Spondylus.

SYNOPSIS OF SPECIES.

Finely ribbed between the primary ribs.	*S. pseudoradula.*
Coarsely ribbed between the primary ribs.	*S. gæderopoides.*

Spondylus pseudoradula, McCoy.

Reference.—Prodromus Pal. Victoria, Decade v., pl. 45, fig. 2 (1877).

Localities.—Victoria: clays near Mount Martha in Port Phillip Bay; claybeds of Muddy Creek; at Fyansford, Bairnsdale, and Mordialloc (*McCoy*).

South Australia: common in the calciferous sandstones of the River Murray Cliffs (*R.T.*).

Spondylus gæderopoides, McCoy.

Reference.—Prodromus Pal. Victoria, Decade iv., pl. 38 (1876); Dec. v., pl. 45, figs. 1 and 3.

Localities.—Victoria: sandy strata of Bird Rock Bluff, near Geelong; in the cream-colored limestone of Boggy Creek, six miles from Sale, Gippsland (*McCoy*).

South Australia: glauconitic limestone and Turritella limestone bands at Blanche Point, Aldinga Bay; in the glauconitic clayey sands, Adelaide bore; in the chalk rock of the Bunda Cliffs, Great Australian Bight (*R.T.*).

FAMILY AVICULIDÆ.

Avicula nasuta, *spec. nov.* Pl. xi., fig. 11; pl. xii., fig. 12.

The aviculid represented on pl. xi., fig. 11, is the best of the few specimens that have come under my observation; it is not only imperfect, but has lost its external shell layer, and a complete diagnosis of the characters is not possible. The figured specimen is a right valve, incorrectly shown as a left valve. However, a fragment illustrated by fig. 12, pl. xii., is complete so far as regards the umbo and anterior wing, the disproportionate length of the latter part in conjunction with the shape of the valve seem to afford specific characters.

Dimensions.—Length, about 40; width, about 20 millimetres.

Locality.—Adelaide bore, in brown clayey sand with glauconitic grains.

Meleagrina crassicardia, *spec. nov.* Pl. ix., figs. 9 and 10.

Shell slightly oblique, roundly quadrate, inequivalve, very inequilateral, left valve moderately tumid, right valve flatter. Hinge-line long, straight, with a distinct cardinal tooth in the young shell; the ligamental area very broad, and flattened externally, cardinal tooth obsolete in the adult. Anterior auricle of the left valve short, tumid, and acutely pointed, that of the right valve depressed, slightly emarginated below at the narrow byssal fissure; posterior wing small but distinctly developed, acutely pointed. The surface shows indistinct, distant striæ of growth, but to the unaided eye appears smooth.

Dimensions.—Young example, pl. ix., fig. 9. Length of hinge, 37; greatest length measured from umbo to the post-ventral margin, 37 millimetres. Average-sized adult specimens measure about 60 millimetres in the transverse diameters.

Localities.—Muddy Creek, Hamilton (young examples only); oyster-beds, North-west Bend Head Station, near Morgan, on the River Murray (adult examples only). *R. T.*

Vulsella lævigata, *spec. nov.* Plate iii., figs. 3*a*—3*b*.

Right valve narrow oblong, attenuated dorsally and rounded ventrally, posterior side nearly straight, anterior side somewhat arched; greatest width in the dorsal-third; umbo a little swollen and elevated, not divergent from the hinge. Surface irregularly concentrically lamellose, especially in the umbonal region. Hinge-line short; but the ligamental socket proportionately long, triangular, erect.

Dimensions.—Length 11, height 29 millimetres.

Locality.—Glauconitic limestone at the base of Witton Bluff, near mouth of the River Onkaparinga.

By the absence of crenulated striæ or scales, and by its form, it approximates to *V. deperdita* of the European Eocene, but that shell is broader with diverging umbos; its resemblance to *V. angustata*, Deshayes, of the Parisian Eocene is very close, from which the present species differs by the large, straight, ligamental pit.

Perna, *sp. ind.*

Locality.—Witton Bluff, at the mouth of the River Onkaparinga. A cast of a large species apparently identical with an undescribed species from the "Trelissick Group," New Zealand.

SUB-FAMILY PINNIINÆ.

Genus Pinna.

Valves convex, longitudinal ribs with erect scales.
P. semicostata.

Valves acutely angulated, longitudinal ribs without scales.
P. sp.

Pinna semicostata, *spec. nov.* Plate xii., fig. 9.

Triangular, elongate, slightly sinuated at the byssal region; valves very convex with abrupt sides, the dorsal half with rather close obsolete longitudinal ribs (about ten) raised into close short semi-cyclindrical scales; the ventral half with strong concentric folds.

Dimensions.—Length of dorsal margin 130, width 65, greatest thickness through both valves 43 millimetres.

Localities.—Oyster banks, Adelaide and Aldinga Bay.

This species has a general resemblance to *P. Zealandica*, Gray, from which it differs by the longitudinal scaly ribs being confined to the dorsal surface, and by its much greater convexity.

Pinna, *sp. indet.*

Apical portions only known. Valves acutely angulated, with faint longitudinal ribs separated by broad interspaces on the ventral slope, crossed by undulose ridges.

Calciferous sandrock, River Murray cliffs, near Morgan.

FAMILY MYTILIDÆ.

Genus Modiola.

Shell ovate-oblong, inflated.	*M. Adelaidensis.*
Shell elongated, inflated.	*M. sp.*
Shell elongated, compressed.	*M. sp.*

Modiola Adelaidensis, *spec. nov.* Pl. xi., fig. 3.

Ovate-oblong, with inflated subterminal beaks, the anterior end very narrow and obtuse; the post-dorsal portion is dilated and becomes gradually flattened, the ventral side is comparatively narrow and convex. Posterior margin broadly subrotund, dorsal margin slightly curved, ventral margin straight, anterior margin rounded, projecting beyond the umbo. Surface with well-defined concentric folds of growth.

Dimensions.—Greatest length, 28; greatest width at right angles to longitudinal diameter, 18; greatest thickness through both valves, 13 millimetres.

Locality.—Glauconitic sands, Adelaide bore.

This fossil species has some resemblance to certain individual varieties of the recent *M. flavida*, but is distinguished by the larger and less anterior umbones.

Modiola, *sp. indet.*

Similar to the last, but longer and narrower; the single specimen known is unfortunately somewhat crushed.

Length, 43; breadth, 17 millimetres.

Locality.—Glauconite sands, Adelaide bore.

Modiola, *sp. indet.*

A compressed elongate shell, with nearly terminal beaks, is indicated by casts in the calciferous rocks on the River Murray, and at Salem, near Callington, on the River Bremer.

Length, 55; breadth, 20; thickness through both valves, 13 millimetres.

Lithodomus, *sp. indet.*

Casts and crypts of a *Lithodomus* in the coral *Plesiastræa Vincenti* occurring at Hallett's Cove indicate a short tumid shell with broad incurved beaks, the anterior end slightly convex, the posterior obliquely obtuse.

Length, 21; breadth, 10; thickness through both valves, 11 millimetres.

Genus Mytilus.

Shell cylindrical tumid.	*M. sp.*
Shell subquadrangular.	*M. subMenkeanus.*

Mytilus, *sp. indet.*

An imperfect specimen of a cylindrical tumid mussel, finely longitudinally striated on the steep ventral slope, has been obtained from the glauconitic limestone at Blanche Point, Aldinga Bay. Length 47, width 15 millimetres.

Mytilus subMenkeanus, *spec nov.*

A complete diagnosis is impossible from the fragmentary state of the specimens, which, however, indicate a species of the general form of the recent *M. Menkeanus*, but with fewer and stouter longitudinal ribs.

Locality.—Hallet's Cove, on the horizon of the oyster banks at Aldinga Bay.

Septifer fenestratus, *spec. nov.* Pl. ix., fig. 1.

Shell elongate-triangular, very inequilateral, equivalve; umbos almost marginal, subacute, curved; anterior side nearly straight, slightly outwardly convex about the middle, rising abruptly to the elevated rounded umbonal ridge; dorsal line straight; post-dorsal area depressed, its margin making an obtuse angle (about 120°) with the dorsal line; ventral margin attenuated, rounded; byssal sinus inconspicuous. Surface ornamented with numerous divaricate subacute ribs, the interspaces shallow, concave, broader than the radial ribs, latticed by stoutish raised lines; also by distant imbricating folds of growth. Hinge thickened anteriorily with a small umbonal shelf (umbonal cavity is filled up at the senile stage of growth); ligamental groove linear, slightly obliquely extending posteriorly; the whole inner margin of the valves crenulated, the crenulations on the hinge line becoming denticulate, and three or four beneath the umbo are much larger than the rest.

Dimensions—Length of hinge-line, 9·5; antero-dorsal to post-ventral margins, 16; thickness through both valves, 8 millimetres. An unusually large specimen has the first two dimensions respectively 28 and 44 millimetres.

Localities.—Muddy Creek; Corio Bay; Schnapper Point, Hobson's Bay, Victoria (*R. T.*).

This Australian fossil *Septifer* proves to be distinct from its congeners. So far as I have been able to make comparisons, it approaches *S. denticulatus*, Lamk., but differs in its high rounded umbonal ridge and its latticed ornament.

GENUS MODIOLARIA.

SYNOPSIS OF SPECIES.

Shell obliquely ovate-oblong. *M. singularis.*
Shell oblong, very inflated, acutely truncated behind. *M. arcacea.*
Shell oblong, moderately inflated, roundly truncated.
Depressed anterior area without rays. *M. semigranosa.*
Depressed anterior area with twelve acute ribs. *M. Corioensis.*

Modiolaria singularis, *spec. nov.* Pl. iii., fig. 7.

Shell obliquely ovate-oblong, equivalve, inequilateral, thin, translucent; umbos large, obtuse, approximate, a little anterior. Surface finely concentrically striated; umbonal ridge obscurely radially lined. Hinge line crenulated, rest of inner margin plain, except post-ventrally, where it is thickened and crenulated, the crenulations corresponding with the radial lines, which are more conspicuous internally than externally.

Dimensions.—Length, 2·5; height, 3; thickness through both valves, 3 millimetres.

Locality.—Muddy Creek, a single perfect shell (*R. T.*).

Though the form approximates to *Crenella*, yet as the hinge characters are proper to *Modiolaria*, I prefer to place it there, despite its abnormal shape and ornamentation.

Modiolaria arcacea, *spec. nov.* Pl. ix., figs. 2*a*—2*b*.

Shell oblong, umbos marginal, very inflated, incurved, somewhat wide apart; anterior margin rounded, obliquely truncated posteriorly, dorsal line slightly arched; posterior area flattened, defined by a prominent umbonal ridge. Anterior radial area narrow, ribs rounded, crossed by lamellæ; posterior radial area extending over the umbonal ridge, rayed with flat ribs about as wide as the depressed interspaces, the whole crossed by equidistant lamellæ.

Dimensions.—Length, 27; height, 12; thickness through both valves, 18 millimetres.

Locality.—Turritella grits at Ardrossan (*O. Tepper*).

Modiolaria semigranosa, *spec. nov.* Pl. iii., fig. 5.

Shell oval-oblong, sub-diaphanous; umbo sub-marginal, rather depressed; anterior radial area obsolete, posterior radial area with sub-acute ribs about as broad as the inter-

spaces; ribs obsoletely granulo-nodulose, except on the flattened area posterior to the regularly rounded umbonal ridge, where they are covered by depressed imbricating lamellæ; inner margin of valve crenulated, denticulate under the umbo.

Dimensions.—Length, 7; height, 4·5 millimetres.

Locality.—Adelaide bore. A left valve (*R.T.*).

Modiolaria Corioensis, *spec. nov.* Pl. iii., fig. 4.

Shell oval-oblong, sub-diaphanous; umbo almost marginal, somewhat depressed, medial smooth area about two-thirds of the length of the shell; anterior radial area with about twelve acute ribs narrower than the angular interspaces; posterior radial area with about 30 flat ribs with linear interspaces. Inner margin of valve crenulated, denticulate under the umbo.

Dimensions.—Length, six; height, four millimetres.

Locality.—Corio Bay, Victoria (*R.T.*).

M. Corioensis is closely related to *M. impacta*, Hermann, and *M. Cumingiana*, Dunker; from the first it differs by its finer and numerous radii, and from the latter in being less gibbous and by its wider medial area.

Two other species of *Modiolaria* have been collected from the oyster banks of the Aldinga cliffs, but in a too exfoliated condition for diagnosis.

Crenella globularis, *spec. nov.* Pl. x., figs. 3*a*—3*b*.

Shell small, thin, translucent, sub-globose, pearly within, equivalve, inflated especially in the dorsal third; umbos a little anterior, obtuse, incurved, approximate; surface regularly cancellated; ligamental groove internal, lanceolate, extending posteriorly; hinge line bordering the ligamental area, minutely transversely denticulated; a small denticle terminates the ligamental groove under the umbo; margin of valves crenulated all round.

Dimensions.—Length, 5; height, 6; thickness through both valves, 7 millimetres.

Localities. — Glauconitic sands, Adelaide bore, many examples; gastropod bed, near Morgan, one example; Muddy Creek, Hamilton; Table Cape, one example (*R.T.*).

This fossil differs only specifically from *Stalagmium margaritacea*, Conrad=*Myoparo costatus*, Lea, of the Eocene of Alabama, which it resembles more than any other congener known to me; it is distinguished by its spherical shape and cancellated ornament. *C. elegans*, Deshayes, of the Parisian Eocene, is another closely related species.

FAMILY ARCADÆ.

SUB-FAMILY NUCULINÆ.

Genus Nucula.

SYNOPSIS OF SPECIES.

Shell smooth, margin not crenulated.	*N. tumida.*
Shell concentrically ridged and radially striated, margin crenulated.	
Obliquely trigonal, folds thin.	*N. Atkinsoni.*
More oblique, folds thick.	*N. semistriata.*
Trigonal, equilateral.	*N. Morundiana.*
Shell with fenestrated ornament.	*N. fenestralis.*

Nucula tumida, Tenison-Woods. Pl. vi., figs. 6*a*—6*b*.

Reference.—Proceedings Royal Soc., Tasmania, for 1877, p. iii.

Shell solid, obliquely trigonal, tumid, truncated posteriorly, slightly produced and rounded anteriorly, wrinkled with consecutive irregular, flattened folds of growth, increasing in thickness from the umbos to the margin; margin acute. Hinge teeth diverging progressively in an increasing series, interrupted by a narrow deep ligamental pit, which is obliquely produced posteriorly; the teeth are lanceolate, high, and lamellar, the distal ones smaller; in the posterior row there are eight, and in the anterior row about thirty. Umbos acute and sharply incurved; lunule shallow, but well defined, wrinkled and broadly lanceolate.

Dimensions.—Length, 21; height, 16; thickness through both valves, 14 millimetres.

Localities.—Tasmania: Table Cape (locality of the type) (*Tenison-Woods* and *R. M. Johnston!*).

Victoria: Muddy Creek, Hamilton (common and large); Corio Bay, Geelong; Schnapper Point, Port Philip.

South Australia: Gastropod bed, Middle Murravian, near Morgan (*R.T.*)

The author of this species states that it is "not unlike the Tasmanian *N. Grayii*, Sow., but is more tumid and conspicuously sulcate," distinctions which I confirm.

Nucula Atkinsoni, *R. M. Johnston.* Pl. iv., fig. 3*a*—3*c*.

Reference.—*Portlandia Atkinsoni*, R. M. Johnston, in Proc. Roy. Soc., Tasm., vol. for 1880, p. 39.

Shell small, obliquely trigonal, subdepressed; the very short posterior slope truncated. Surface of valves concentrically finely ridged; the ridges increase in size, and frequently anastomose towards the centre and margin, and are traversed

by fine radial threads, which form an open tessellated sculpture. Umbos sharply incurved; lunule shallow (scarcely defined), broadly lanceolate; ligamental pit inconspicuous; cardinal teeth lamellar, eight on the posterior and about 20 on the anterior slope. Edge of the ventral half of the valves minutely crenulated.

Dimensions.—Length, 7·5; height, 6·5; thickness through both valves, 4 millimetres.

Localities.—Table Cape, Tasmania (*R. M. Johnston*); Gastropod bed of the Middle Murravian, near Morgan (*R. T.*); Corio Bay, Geelong (*R. T.*).

The radial sculpture is not always visible by the aid of a pocket-lens, but the crenulated margin and the radial lines which proceed from it towards the interior are always discernible.

This shell has been wrongly placed in *Portlandia*, which is a *Yoldia* having the valves posteriorly closed, whilst it has the simple pallial line and other characters proper to *Nucula*.

Nucula semistriata, *spec. nov.* Pl. iv., figs. 5*a*—5*b*.

Shell small, obliquely trigonal, moderately depressed; the very short posterior side roundly truncated; anteriorly produced and rounded at the extremity. Surface with depressed folds of growth, somewhat retroflexed, the folds increasing in size, and here and there anastomising, towards the front where the interspaces are conspicuously radially ridged; posterior and anterior slopes radially striated. Umbos rather elevated, sharply recurved, lunule inconspicuous. Edge of valves crenulated. Ligamental pit scarcely defined.

Dimensions.—Length, 5·5; height, 4·25; thickness through both valves, 3 millimetres.

Localities.—Turritella clays, Blanche Point, Aldinga Bay; glauconite sands, Adelaide bore (*R. T.*).

This species differs from *N. Atkinsoni* by its greater obliquity and the thick retroflexed folds.

Nucula Morundiana, *spec. nov.* Pl. iv., figs. 2*a*—2*b*.

Shell minute, tumid, solid, trigonal, equilateral; posterior side obscurely angled and flattened above; anterior side obtusely rounded; umbones obtuse; surface ornamented with regular, equal rounded, concentric ribs, and microscopic radial striæ; inner margin of valves minutely denticulated.

Dimensions.—Length and height 3, thickness through both valves 2 millimetres.

Localities.—Muddy Creek, Hamilton, and the calciferous sandstones of the River Murray-cliffs near Morgan.

The specific name is derived from the aboriginal name of the Lower Murray River.

This minute shell is not the young of *N. Atkinsoni*, and differs from *Leda lucida*, T. Woods, by the equality of the transverse diameters of the valves.

Nucula fenestralis, *spec. nov.* Pl. iv., fig. 4.

Shell minute, ovate-oblong, somewhat tumid, umbo in the posterior-third; the shorter posterior side with a rounded margin; the anterior side roundly truncated. Surface ornamented by equidistant and equal-sized radial and concentric ribs; edge of valve crenulated.

Dimensions.—Length about 2, height about 1¼ millimetres.

Locality.—Table Cape, Tasmania (*R. T.*).

The peculiar feature of this fossil is the subcentral umbo and the gross cancellated sculpture.

GENUS LEDA.

SYNOPSIS OF SPECIES.

A. Non-rostrated; ovate-quadrate.	*L. obolella.*
More circular and depressed.	*L. planiuscula.*
B. Rostrated.	
Elongately-lanceolate.	*L. Huttoni.*
Elongately-oval.	*L. acinaciformis.*
Ovate-trigonal or pyriform	
Gradually acuminately-rostrated.	*L. apiculata.*
Abruptly rostrated and compressed.	*L. leptorhyncha.*
Oblong-ovate.	*L. lucida.*
Transversely-ovate, posterior side the shorter.	*L. prælonga.*
Rostral prolongation, biangulate.	
Oblong-subovate.	*T. Woodsii.*
Ovate-trigonal.	*L. crebricostata.*

Leda obolella, *spec. nov.* Pl. v., figs. 3*a*—3*b*.

Shell small, thin, ovate-quadrate, slightly inequilateral, depressed; umbos very small, slightly recurved, almost central; dorsal margin regularly sloping, anterior margin roundly truncate, the antero-dorsal area slightly depressed; posterior margin rounded, surface faintly concentrically striated; lunule obsolete; hinge teeth small, curved, about 15 on each side of a rather broad, erect, triangular cartilage pit.

Dimensions.—Length, 11·5; height, 9·5; thickness through both valves, 4 millimetres.

Localities.—Not uncommon at Muddy Creek; Schnapper Point; gastropod bed, Middle Murravian, near Morgan (*R.T.*).

This fossil differs from all living species, but has some re-

semblance to some species of *Yoldia;* it, however, does not belong to that genus, as the valves are closed, and the pallial sinus is small. It recalls some of the Jurassic species, notably *L. subovalis*, Goldfuss, of the European Lias.

Leda planiuscula, *spec. nov.* Pl. v., fig. 2.

Shell minute, similar to *L. obolella:* comparing equal-sized specimens of each, *L. planiuscula* is more depressed, and the outline approaches more to the circular.

Dimensions.—Length, 5; height, 4·5 millimetres.

Locality.—Adelaide bore.

Leda Huttoni, Tenison-Woods. Pl. vi., fig. 4.

Reference.—Proc. Linn. Soc., N.S.W., vol. iii., p. 239, tab. 21, fig. 2, 1878.

Shell small, depressed, thin, fragile, shining, transversely elongate, pyriform, concentrically irregularly striate and broadly sulcate, radially finely striated; posterior side much produced and slightly obliquely truncated at the end; obtusely triangulated. Anterior side short, rounded. Cardinal teeth numerous, minutely angular.

Dimensions.—Length, 11; height, 5 millimetres.

Localities.—Muddy Creek, Hamilton, where it is common!; Table Cape!; Adelaide bore; and Turritella clays, Aldinga (*R.T.*).

The specimens from Adelaide and Aldinga are a little more inflated, and the anterior side shorter, whilst the post-dorsal margin is sloping and not elevated at the end; the arched rostral prolongation is very conspicuous in young shells from Muddy Creek, but the character is not constant.

Leda acinaciformis, *spec. nov.* Pl. v., figs. 6*a*—6*b*.

Shell depressed, elongate-oval; umbo subcentral; anterior side rounded; dorsal margin sloping anteriorly, and slightly elevated at the posterior end; ventral margin strongly arcuate, curved upwards posteriorly to form a rostral prolongation. Umbonal ridge well defined, above which is a narrow lanceolate area. Surface sculptured with concentric, thick, flattened ribs. The regular convexity of the anterior surface is interrupted by a narrow, flattened, triangular area extending from the umbo to the antero-ventral margin, rendered conspicuous by the interrupted curve of the concentric ribs. Lunule lanceolate, longitudinally ridged.

Dimensions.—Length, 17; height, 8; thickness through both valves, 6 millimetres.

Locality.—Muddy Creek.

L. acinaciformis has the general form and ornament of

L. crassa, Hinds, its nearest ally in recent creation, from which it differs in its depressed elongated shape.

Leda apiculata, *spec. nov.* Pl. ix., figs. 4*a*—4*b*.

Shell ovate-subtrigonal, ventricose, inequilateral; umbo moderately inflated, rounded, recurved, in the anterior half. Anterior side inflated, rounded; ventral border arched, posterior side shortly acuminately rostrated; antero-dorsal margin sloping, post-dorsal area depressed, slightly elevated at the end. Whole surface marked with concentric raised threads narrower than the interspaces. Lunule well defined, striated; cardinal teeth about fifteen on each side of a small triangular ligamental pit.

Dimensions of figured specimen.—Length, 9·5; height, 5·5; thickness, 4 millimetres; of a larger example the longitudinal and transverse diameters are 11 and 6·5 millimetres respectively.

Localities.—Abundant in the Turritella clays at Blanche Point, Aldinga Bay; also in the glauconite sands, Adelaide bore; Muddy Creek and Schnapper Point, Victoria.

Leda leptorhyncha, *spec. nov.* Pl. x., figs. 5*a*—5*b*.

Shell minute pyriform, subventricose, much inflated in the middle; umbos subcentral, slighty elevated and recurved. Anterior side rounded, with the dorsal margin sloped; ventral border arched very abruptly sloping upwards posteriorly; posterior side a little the longer, much compressed, and acuminately rostrated above. Surface marked with concentric ridges and striæ, more or less obsolete on the beak. Lunule narrow lanceolate. Cardinal teeth, about 15 on each side of a small but well-defined triangular cartilage pit.

Dimensions.—Length, 5; height, 3; thickness through both valves, 2 millimetres.

Localities.—Turritella marls, Aldinga Bay; glauconite sands, Adelaide bore. Very common.

This species is not the young of *L. apiculata*, from which it differs by the contraction and compression beneath the rostrum, by its irregular sculpturing, and by its shape. Examples of *L. apiculata* of the size of the present species differ from the adult only by the post-dorsal side being straight, not elevated at the end.

Leda lucida, Tenison-Woods. Pl. vi., figs. 7*a*—7*b*.

Reference.—Proc. Linnean Soc., N.S.W., vol. iv., p. 3, t. 1, fig. 5 (1879).

Shell thick oblong, subventricose, umbo almost central, depressed, very slightly recurved; dorsal margin sloping an-

teriorly ; anterior side rounded ; ventral margin rather straight in the middle, abruptly sloping upwards posteriorly ; posterior side somewhat angular, shortly acuminate above. Surface marked with concentric folds and striæ of growth. Lunule well-defined, elliptical, striated ; cardinal teeth, 20 in front row, 15 in the posterior row.

Dimensions.—Length, 18; height, 11; thickness through both valves, 8 millimetres.

Localities.—Corio Bay ; common at Muddy Creek ; Schnapper Point ; and near Morgan (*R. T.*)

L. lucida was established upon a minute shell, which I have been enabled to trace through various stages of growth to the moderately large-sized example figured on pl. vi., fig. 7. The original diagnosis reads as follows:—"Shell small, tumid, solid, polished, equilateral, almost ovate, regularly concentrically ribbed ; ribs rounded equal ; posterior side scarcely produced, subacutely angular, posterior angle scarcely sulcate ; anterior side short, obtusely rounded, umbone subacute. Long. 3·5, lat. 5·5, alt. 2 millimetres. Muddy Creek."

Professor McCoy, in Rep. Geol. Surv. Victoria, 1875, p. 22, figures the cast of a shell obtained at Stawell, which he says "is the *Nucula Marthæ* (McCoy), an extinct species common in the Oligocene Tertiary beds between Mount Eliza and Mount Martha." I have no doubt that the *N. Marthæ* above referred to is conspecific with *L. lucida*, though of the many examples in all stages of growth from that particular locality which I have examined, I cannot find one to match the drawing in the Geol. Surv. Report. The drawing may imperfectly represent the shell; however, as it does not serve for identification, and as no diagnosis has been published of the species, I prefer to employ the name given by Tenison Woods.

Leda prælonga, *spec. nov.* Pl. xii., figs. 4*a*—4*b*.

Shell small, transversely ovate, very inequilateral, rather compressed, smooth, shining ; umbones post-median, inconspicuous ; anterior side ventricose, rounded, produced ; posterior side short, rather attenuated and bluntly acuminate ; valves closed ; pallial sinus conspicuous.

Dimensions.—Length, 4; height, 2 ; thickness through both valves, 1 millimetres.

Localities.—Table Cape, Tasmania; and Muddy Creek, Hamilton, Victoria.

This is a very distinct species, and cannot be mistaken for young examples of associated species ; it makes some approach to *L. leptorhyncha*, but differs from it by its shape and the position of its inconspicuous umbones.

Leda Woodsii, *spec. nov.* Pl. ix., fig. 8.

Synonym.—*L. inconspicua*, Tenison-Woods, in Proc. Linn. Soc., N.S.W., vol. iii., p. 139, t. 21, fig. 3, 1878 (*non* A. Adams).

Shell small, compressed, oblong subovate; umbos post-median, small, depressed; posterior side rather longer than the anterior side, obtusely truncated and acuminated at the end; anterior side rounded, somewhat attenuated; dorsal margin sloping anteriorly, nearly straight posteriorly. An angular posterior ridge originating at the umbo circumscribes a triangular depressed area. Surface finely concentrically ribbed, less conspicuously so on the anterior side; the ribs pass over the umbonal ridge on to the depressed area above. Lunule ill-defined, narrow elongate; ligamental pit triangular, deeply sunk.

Dimensions.—Length, 12; height, 6; thickness through both valves, 3·5 millimetres.

Localities.—Muddy Creek, Hamilton (*Ten. Woods!*); gastropod bed, Middle Murravian, near Morgan (*R.T.*).

The Rev. J. E. Tenison-Woods figures a young shell of this species under Adams' name of *L. inconspicua*. Certainly it closely resembles Reeve's figure of that species, but at later stages of growth the resemblance ceases, and the general form is that of *L. Dorhnii*, Hanley. Without specimens it would not be possible, I think, to differentiate the fossil from the living species above named; but the result of an actual comparison of specimens is that the fossil differs in the following particulars:—Hinge line more arched, anterior side more attenuated, the concentric ridges more numerous and finer.

Young examples of *L. Woodsii* differ from *L. crebrecostata*, Woods, in being more oblong and with finer concentric ridges, both agreeing in the short triangulated rostral prolongation.

Leda crebrecostata, Tenison-Woods. Pl. v., figs. *5a*—*5b*.

Reference.—Proc. Royal Soc., Tasmania, vol. for 1877, p. .

Shell small, moderately depressed, transverse trigonal, narrowly oblong; umbo post-median; anterior side the longer roundly obtuse, posterior side shortly rostrated, triangular, rather compressed and obtusely truncated at the end. Surface regularly concentrically ridged with equal rounded ribs.

"Hinge line inconspicuous and short, anterior subligamental area distinct.

"Transverse length, 5; breadth, 8; thickness of both valves joined, 3 millimetres" (*T. Woods*).

Locality.—Table Cape (*R. M. Johnston!*).

It is smaller and less oblong than *L. Dohrnii*, Hanley, but like it distinguished by the abrupt angulation of the posterior margin and the concentric thick rounded ridges.

SUB-FAMILY PECTUNCULINÆ.

Genus Limopsis.

SYNOPSIS OF SPECIES.

Smooth or concentrically wrinkled, radial lines absent or not prominent.
  Elongate-ovate, no radial ornament. *L. insolita.*
  Ovate-orbicular; thick, concentrically ridged, and finely radiately striated. *L. aurita.*
Radial ornament prominent.
  Radial ribs simple; cancellate. *L. Belcheri.*
  Radial ribs bifurcate; strong concentric folds. *L. multiradiata.*

Limopsis insolita, *G. B. Sowerby.*

References.—*Trigonocœlia insolita*, Sow. in Darwin's Geol. Obs. on S. America, 1846; p. 608, t. ii., figs. 20-21., 2nd ed. *Limopsis insolita*, Zittel in Voy. Novara, Palæont., p. 48, t. xiii., fig. 1, 1864; *id.*, Hutton, Cat. Tert. Moll. of New Zealand, p. 28, 1873.

Localities.—South Australia: in a black clayey sand at the base of the sea cliff, half mile north of jetty in Aldinga Bay, very abundant; in a similar bed, Adelaide bore. New Zealand: Pareora Series, at Nelson, Kaniera, Waikari (*Hutton*); also Santa Cruz, Patagonia (*Darwin*).

Limopsis aurita, *Brocchi.*

References.—*Arca aurita* (Br.), Conch. Foss. Subapenninæ, t. xi., fig. 9. *Limopsis aurita*, McCoy, Prodr. Pal. Victoria, Dec. II., t. xix., figs 5-7 (1875).

Synonym.—*Limopsis Zealandica*, Hutton, Cat. Tert. Moll., N.Z., p. 28 (1873).

Localities.—Victoria: At Bird-rock Point, near Geelong; at Schnapper Point and at Mornington, Port Phillip (*McCoy*); Muddy Creek (*R. T.*). Tasmania: Table Cape (*R. M. Johnston*). Also fossil in European Miocene and Pliocene, and recent in the Arctic and Southern Oceans.

Limopsis Belcheri, *Adams* and *Reeve.*

References.—*Pectunculus Belcheri*, Adams and Reeve, in Voy. of the Samarang, t. xxii., f. 5, p. 76 (1850). *Limopsis Belcheri*, McCoy, Prodv. Pal. Victoria, Dec. II., t. xix., figs. 8-9 (1875).

Localities.—Victoria: Balcombe Bay!; Muddy Creek!; Moorabbin; Corio Bay; and west of mouth of Gellibrand River (*McCoy*). South Australia: Calciferous sandstone near Morgan on the River Murray; raggy limestone at Edithburg, Yorke Peninsula. Recent off the Cape of Good Hope

(Samarang Exped.); St. Vincent Gulf, Guichen Bay, and Portland, Southern Australia.

Limopsis multiradiata, *spec. nov.* Plate xii., figs. 1*a*—1*b*.

Shell ovate-orbicular, slightly inequivalve and oblique, thick, convex; umbones prominent, concentrically irregularly folded and radially ribbed; ribs thin, very numerous, narrower than interspaces, bifurcating at about the middle; cartilage pit large, equilateral, three or four very small teeth under it, six or seven larger ones on each side.

Dimensions.—Length from umbo to the post-ventral margin, 9·5; greatest width, 10; thickness through both valves, 5 millimetres.

Localities.—Glauconite argillaceous sands, Adelaide bore; and Turritella limestone bands, Blanche Point, Aldinga Bay.

Among the Australian congeners this species resembles *L. aurita*, somewhat in shape though less oblique, and the undulating folds are thick and irregular. The conspicuous radial ribs ally it to *L. Belcheri*, which is distinguished by a peculiar style of tesselated sculpture produced by wavy concentric fringes; in *L. multiradiata* the radial ribs bifurcate, and only in young shells is there present a fenestrated ornament produced by the crossing of simple concentric threads.

LIMARCA, *gen. nov.*

Derivation from Lima and Arca. Type, L. angustifrons, spec. nov.

Very inequilateral; cartilage pit lanceolate, excavated on the hinge line, directed backwards; hinge line with anterior denticles and posterior elongated longitudinal teeth. No area under the umbo.

L. iniquidens, Sanberger, in Die Conchylien des Mainzer Tertiarbeckens, 1863, p. 347, t. 29, fig. 5, is apparently congeneric.

The characters of the cardinal region recall *Crenella* in Mytilidæ, but the muscular impressions determine its place in Arcadæ, whilst its similitude to *Limopsis* is great. It agrees with *Trigonocœlia* in the absence of an area between the umbo and the hinge line, and in this particular differs from *Limopsis* and *Cyrilla;* from *Trigonocœlia* it differs by the fewness of the cardinal teeth, the posterior of which are longitudinal and not cross-set.

Limarca angustifrons, *spec. nov.* Plate viii., figs. 5*a*—5*b*.

Shell small, subrhomboidal, convex, equivalve, very inequilateral; anterior margin regularly rounded; posterior roundly truncated; ventral margin regularly convex outwardly. Sur-

face ornamented with broadish depressed transverse and narrow radial ribs. Umbones minute, subterminal, obtuse; no area; hinge-line thick, obtusangular; ligamental pit excavated in the hinge-line, oblique, lanceolate, directed backwards; anterior to the pit are three suberect denticles, and posteriorly four longitudinal teeth. Internal margin of valves crenulated, more prominently so in the posterior part.

Dimensions.—Length from umbo to post-ventral margin, 5·5; width, 5·5; thickness through both valves, about 4 millimetres.

Localities.—Turritella-beds, Blanche Point, Aldinga Bay, and glauconitic argillaceous sands, Adelaide bore.

This species has a general resemblance to *L. iniquidens*, Sandb., but wants the auriculated antero-dorsal margin, and has fewer hinge teeth.

Genus Pectunculus.

synopsis of species.

I. Finely radially striated.	
Orbicular, slightly oblique.	*P. Cainozoicus.*
II. Radially ribbed.	
Ribs, about 39; wider than long.	*P. laticostatus.*
Ribs, about 29; longer than wide.	*P. McCoyii.*
Ribs, about 29; subtrigonal.	*P. subtrigonalis.*
Ribs, about 24, elevated; orbicular, tumid.	*P. convexus.*
Ribs, 40 or more; orbicular, depressed.	*P. lenticularis.*

Pectunculus Cainozoicus, *T. Woods, sp.* Plate x., figs. 8*a*—8*b*.

Reference.—*Cucullæa Cainozoica*, T. Woods, Proc. Roy. Soc., Tasmania, for 1876; p. 111.

"Shell roundly trigonal, oblique, globose, smooth, faintly and closely marked with radiating ribs and concentric striæ, the latter well defined and somewhat rugose at the margin and sides. Umbones very acute and recurved. Ligamental area arched, broad, with six straight grooves on each, which are well defined, and overlap each other alternately under the umbo; hinge-teeth, 6-7, bent under the hinge, and then bicuspidate. Margin of valves finely pectinated with very distinct crenulations, which continue in young shells all round as far as the hinge. Young shells are also more quadrate, and have the angular ears slightly developed" *(T. Woods)*.

Var., pl. x., figs. 8*a*—8*b*.—This differs from the type in being more orbicular, less narrowed at the hinge-line—characters very conspicuous in young shells. The variety is hardly separable from *P. pulvinatus*, Lamk., of the Parisian Eocene, which is, however, more gibbous at the umbones, and is equilateral.

Dimensions.—Length, 45; width, 42; thickness through valves, 33 millimetres.

Localities.—*Type*, Table Cape (*R. M. Johnston!*). *Var.*, common at Muddy Creek; Adelaide bore.

Pectunculus laticostatus, Quoy and Gaimard (?).

References.—Voy. de l'Astrolabe, t. 77, figs. 1-6, vol. iii., p. 466, McCoy, Prod. Pal., Victoria, Dec. ii., t. xix., figs. 10-14.

Localities.—Bird Rock, Geelong; of small size, Schnapper Point (*McCoy*).

This identification of the fossil and the living species has been disputed by Mr. R. M. Johnston. The material at my command is not sufficient to permit me to express an opinion, though I have little hesitation in accepting Prof. McCoy's determination in respect to the fossils represented by fig. 10.

Pectunculus McCoyii, R. M. Johnston.

Reference.—Proc. Roy. Soc., Tasm., for 1884, p. 199.

The characteristic shell of Table Cape, previously referred to the living species, *P. laticostatus*, is regarded by Mr. Johnston as specifically distinct, with the following differential characters:—Ribs, 29 (not 39), less solid, longer than broad, more convex towards the margin; hinge teeth, 10.

A thin, sub-orbicular, narrowed at the hinge, depressed shell, never exceeding 30 millimetres diameter, very abundant at Muddy Creek, is tentatively included under *P. McCoyii*.

Localities.—Table Cape, Tasmania; Cape Schank, Victoria (*R. M. Johnston!*); Muddy Creek and Schnapper Point (*R.T.*).

Pectunculus subtrigonalis, *spec. nov.* Pl. xi., figs. 6*a*—6*b*.

Shell solid, somewhat sub-trigonal, sub-equilateral, oblique, slightly produced posteriorly, moderately convex, radiately ribbed; ribs about 29, rounded, separated by flat narrower interspaces, the whole surface crossed by regular, sub-distant, subimbricating lamellæ, and a few folds of growth; umbones small, approximate; hinge line very short, ligamental area small; cardinal teeth eight in front and seven behind the edentulous centre; internal margin of valves strongly crenate.

This species is conspicuous by its narrow hinge line, the valves attaining the greatest transverse diameter at about four-sevenths the distance from the umbo to the front.

Dimensions.—Length, 32; width, 31; thickness through both valves, 19 millimetres.

Localities.—Common in the calciferous sandrock of the River Murray cliffs near Morgan (*R.T.*); rare Muddy Creek (*J. Dennant!*).

Pectunculus convexus, *spec. nov.* Plate xi., figs. 7*a*—7*b*.

Shell solid, orbicular, but slightly transverse, tumid; subequilateral; umbones approximate, radiately ribbed. Ribs about 24, rounded, elevated, interspaces concave wider than the ribs, crossed all over with thick concentric wavy laminæ becoming finer towards the front. Inner margin of valves strongly crenate. Cardinal teeth about ten on each side.

Dimensions.—Length, 31; width, 33; thickness through both valves, 22 millimetres.

Localities.—Muddy Creek. Imperfect specimens oyster banks North-west Bend on the R. Murray; Hallett's Cove and Aldinga Bay.

This species has some resemblance to the recent *P. flabellatus*, T. Woods, but is more inflated and with wider interspaces between the ribs.

Pectunculus lenticularis, *spec. nov.* Plate xi., fig. 1.

Shell rather thin, orbicular, but slightly transverse, depressed, equilateral; radiately ribbed. Ribs numerous (more than 40), very fine, rounded, narrower than, or about as wide as, the interspaces, crossed all over with fine concentric wavy lines. Inner margin of valves narrowly toothed; umbones very small, approximate; ligamental area very small, cardinal teeth 11 on each side.

Dimensions.—Length, 31; width, 29; greatest thickness through both valves, at about one-third the distance from the front, 12 millimetres.

Locality.—Glauconitic sands, Adelaide bore.

SUB-FAMILY ARCINÆ.

Synopsis of Species.

Arca.

Valves gaping ventrally; umbones high, wide apart.
- Hinge teeth numerous, transverse. *A. pseudonavicularis.*
- Hinge teeth few, all oblique. *A. equidens.*

Barbatia.

Valves closed or sinuated ventrally; umbones approximate; teeth numerous, transverse, gradually becoming larger and more oblique towards the extremities.
- Transversely oblong; left valve radially ribbed; right valve smooth, with contused impressions. *B. dissimilis.*
- Oblong with concentric ridges thickly granulose or plicate; gibbous. *B. crustata.*
- Elongate-oblong, with concentric fimbriated ridges. *B. celleporacea.*

Surface with granular ribs.

Elongate, suboval; umbones subanterior. *B. limatella.*

Id., posterior side attenuated. *B. consutilis.*

Trapezoidal, posteriorly keeled; umbones anterior. *B. simulans.*

Ovate-oblong; strongly ribbed on the posterior slope. *B. pumila.*

MACRODON.

Valves closed; umbones approximate; posterior teeth laminar horizontal; anterior teeth few, short, oblique.

Sculpture of flat concentric ridges transversed by distant riblets. *M. Cainozoicus.*

Arca pseudonavicularis, *spec. nov.* Pl. xi., fig. 8.

Shell elongate, subtrapeziform, tumid; front margin obliquely rounded; posterior margin somewhat attenuated, obliquely truncated, with the posterior slope strongly angulated; hinge line straight. Umbones anterior, distant, acute; ventral margin sinuately excavated; inner margin of valves plain. Surface ornamented with concentric fimbriated folds; posterior slope unequally, radiately ribbed. In young specimens the surface is unequally cancellated, and the radial ribbing on the anterior and posterior areas is very pronounced. Hinge area broad, with a well defined triangular area under the beak; teeth very numerous, small, transverse.

Dimensions.—Greatest length, 27; width, 12·5; thickness through both valves, 14 millimetres.

Localities.—Adelaide bore (*R.T.*); Table Cape (*R. M. Johnston!*).

The living analogue of this species is *A. navicularis*, Brug., as known to me from Port Darwin, from which it differs in the umbones being not near the front, in the somewhat emarginate anterior side, and in the finer ribbing on the posterior slope.

Arca equidens, *spec. nov.* Pl. xi., fig. 9.

Shell elongate-oblong, tumid, with a depression extending from the umbo to the ventral margin, which is somewhat insinuated; anterior side acutely angular, posterior side elongated, obtusely angular or truncated, with a roundly angular posterior slope; hinge line straight. Umbones at the anterior third, narrow, acute, wide apart. Surface with concentric, imbricating ridges and radial threads or ribs. The ornament varies in respect to the relative strength of the radial ribs and concentric ridges; in some it is of the nature of fimbriated concentric ridges, whilst in the other extreme it consists of radial ribs variously thickened at the intersections with the

concentric lines. Inner margin of valves not crenulated. Hinge area broad, longitudinally fine-lined; central tooth V-shaped, succeeded on each side by about seven equal lamelliform oblique teeth, delicately crenulated on the sides.

This species cannot be mistaken for *Arca pseudonavicularis*, whilst the character presented by the hinge teeth separates it from all congeners.

Dimensions.—Length, 8·5; width, 4; thickness through both valves, 6 millimetres.

Localities.—Abundant in the lower beds Blanche Point, Aldinga; and Adelaide bore.

Barbatia dissimilis, *spec. nov.* Pl. xi., figs. 4 and 5.

Shell transversely-oblong, somewhat tumid, obliquely rounded in front, subobliquely truncated behind, with a roundly angulated posterior slope. Umbones at about the anterior-third, acute, moderately wide apart; ventral and dorsal margins nearly parallel, front margin not sinuated. Left valve ornamented with radial ribs crossed by concentric threads, producing imbricating granulations at the intersections. Right valve with equidistant concentric folds, with pitted sculpture between them. The peculiar sculpture may be the scars of deciduous imbricating scales, traces of which are preserved on the posterior and anterior slopes, particularly on the former, where they are grouped in radial lines. Hinge area narrow, with a few marginal longitudinal ridges, and a transverse lanceolate groove beneath the beak and indenting the hinge line. Teeth few, large, transverse, but becoming slightly oblique towards the ends; about eight in front, and about fourteen behind the umbo.

Localities.—Very common in the Turritella limestone bands, Blanche Point, Aldinga Bay; and in the argillaceous glauconitic sands, Adelaide bore.

Dimensions.—Length, 7; width, 5; thickness through both valves, 4 millimetres.

Barbatia crustata, *spec. nov.* Pl. ii., fig. 16.

Shell small, oblong, tumid, medially impressed, and sinuated ventrally. Umbones broad, incurved, approximate, anterior. Anterior side short, roundly truncate; posterior side elongated, obtusely truncated; posterior slope very narrow, precipitous. Surface with thick concentric lamellæ, radially plicate or granular. Inner margin of valves plain; hinge teeth numerous, small, transverse.

Dimensions.—Length, 7; width, 3·5; greatest thickness through both valves on the posterior ridge, 6 millimetres.

Locality.—Oyster beds of the River Murray cliffs at the North-West Bend.

Has a resemblance to *Arca equidens*, mihi, but with a coarser ornament, shorter posterior side, &c.

Barbatia celleporacea, *spec. nov.* Pl. x., fig. 10.

Shell elongate-oblong, rather compressed, inequilateral; anterior side short, narrow, acutely angular; posterior side elongated, obtusely angular, with the posterior slope carinated; ventral side slightly sinuated. Hinge line straight. Umbones anterior, approximate, depressed, acute. Surface ornamented with concentric folds raised into frills; the latter in aged specimens pass into uncinate scales or hollow tubercles, the fimbriations within the interstitial spaces not infrequently perforated, the entire ornamentation simulating a polyzoal growth, as in *Cellepora*. The concentric folds show coarse distant growth lines. Internal margin strongly crenulated; ligamental area very narrow; teeth small, numerous in a transverse series, increasing in size and becoming slightly oblique towards the extremities.

Dimensions of a large specimen:—Greatest length, 26; width, 10; thickness through both valves, 7·5 millimetres.

Localities.—Victoria: Common at Muddy Creek; Schnapper Point (*R.T.*). Tasmania: Table Cape (*R. M. Johnston!*).

This species has much resemblance to *Barbatia* (*Acar*) *laminata*, Angas, inhabiting South Australian waters, and therefore to *Arca squamosa*, Lamk., but it is more elongate, not so tumid, with narrow acute umbones, and the front margin more angular.

Barbatia limatella, *spec. nov.* Plate x., fig. 2.

Shell elongate suboval, moderately inflated, inequilateral; umbones subanterior, incurved very close together; anterior side short, rounded; posterior margin obliquely roundly truncated; hinge-line straight; ventral margin straight or slightly arcuate, slightly insinuated medially. Surface radiately fine-ridged, dichotomously dividing, more or less granulose or scaly where crossed by the numerous equidistant imbricating folds; the depressed posterior slope conspicuously radiately ridged. Hinge area very narrow, almost wanting in young specimens, divaricately furrowed; central teeth numerous, small, transverse, with a few short, oblique, fold-like teeth towards the extremities.

Dimensions of a large specimen.—Length, 50; width, 28; thickness through both valves, 19 millimetres.

Localities.—Sandy clays at Blanche Point, Aldinga Bay, and argillaceous glauconitic sands, Adelaide bore.

The living analogues of this fossil species are *B. lima*, Reeve, and *B. decussata*, Sby. From the first it differs in its coarser ornament, particularly on the less angular posterior slope, and in its longer posterior side. From the second, with which it agrees well in ornament and in general shape, it differs by its longer and straighter hinge-line, longer posterior side, and by the stronger and more laminar and oblique teeth on the marginal areas.

Barbatia consutilis, *spec. nov.* Plate ii., fig 15.

Shell elongate-oval, moderately convex, medially impressed; umbones subanterior, incurved, close together; anterior side short, rounded; posterior side elongated, attenuated, obliquely truncated. Surface radiately fine ridged, more or less granulose where crossed by the equidistant concentric threads; the worn surface regularly tessellated.

Dimensions of a large specimen.—Length, 41; width, 20; thickness through both valves, 16 millimetres.

Locality.—Common at Muddy Creek.

Similar to *B. limatella*, but especially distinguished by its attenuate posterior side.

Barbatia simulans, *spec, nov.* Plate xi., fig. 10.

Shell transversely trapezoidal, moderately inflated, very inequilateral, umbones anterior, incurved, close together; anterior margin very short, obtusely roundly truncate, posterior side elongated, obtusely truncated with a well-defined posterior slope; hinge-line straight; ventral margin inconspicuously insinuated. Surface with flattish granular ridges wider than the interspaces. Hinge area very narrow, with about seven divaricating cartilage furrows; teeth numerous, transverse, becoming more oblique towards the extremities.

Dimensions.—Length, 34; width, 19; thickness through both valves, 14 millimetres.

Localities.—Muddy Creek, Hamilton; oyster banks, North-West Bend, on the R. Murray.

This species is closely related to *B. lima* and *B. limatella* from which it is distinguished by the shorter anterior side, obtusely truncated, and by its granular ornamentation most conspicuously so on the posterior slope. *B. limatella* wants the posterior angulation of this species.

Barbatia pumila, *spec. nov.* Pl. x., fig. 7.

Shell small, ovate-oblong, moderately convex, inequilateral; umbones anterior, rather broad, obtuse, approximate; anterior side short, rounded; posterior side depressed, subangular, its margin obtusely roundly truncate; dorsal and ventral margins

straight; valves closed, inner margin crenulated, conspicuously so on the posterior side. Surface ornamented by flatly rounded radial ribs, broader than the interspaces, and concentric striæ and folds, producing granular thickenings at the intersections; the radial ribs are very prominent on the posterior slope. Hinge area very narrow, teeth numerous, transverse, becoming larger and slightly oblique towards the extremities.

Dimensions.—Length, 9; width, 5; thickness through both valves, four millimetres.

Locality. — Not uncommon in the upper beds at Muddy Creek, Hamilton.

Macrodon Cainozoicus, *spec. nov.* Pl. x., fig. 4.

Shell elongate, subrhomboidal, somewhat compressed, inequilateral; anterior side short, acutely angular, somewhat acuminate; posterior side elongated, truncated with a well defined posterior slope; hinge line straight; ventral margin insinuated in the middle, the antero-ventral line rapidly ascending. Umbones subanterior, not widely separated, slightly incurved. Surface with concentric flat ridges, broader than the deep sulci, and radial threads interrupted by the furrows. Internal margins of valves smooth; ligamental area narrow, with a few longitudinal ridges; teeth radiating from an edentulous centre, five or six anterior, short, oblique; posterior several, laminar, parallel with the hinge line.

Dimensions of a large specimen:—Length, 27; width, 10; thickness through both valves, 9 millimetres.

Localities.—South Australia: calciferous sandstones, River Murray Cliffs, near Morgan; Adelaide bore; Aldinga. Victoria; Schnapper Point, Muddy Creek and Corio Bay (*R.T.*).

Prof. Hutton, in Trans. N.Z. Institute, vol. xvii., p. 331, 1885, describes an ark under the name of *Macrodon australis*, which I think, after examination of an authentic specimen, would be better placed in the genus *Cucullæa*. My species does not conform with the typical species of the genus, but it is generically identical with certain Jurassic and Cretaceous forms which have been associated therewith.

Genus Cucullæa.

SYNOPSIS OF SPECIES.

Very gibbous, with granulated ridges. *C. Corioensis.*
Not so gibbous; umbones narrower, ribs more numerous, narrower, and finer. *C. Adelaidensis.*

Cucullæa Corioensis, McCoy.

Reference.—Prodr. Pal., Victoria, Dec. III, t. 27, figs. 3-5, 1876.

Localities.—Victoria: common at most of the localities; Corio Bay; Bird Rock Point; Point Addis; Gellibrand River; Muddy Creek!; Mordialloc; Dog Island, Leigh River; Bairnsdale; Jemmy's Point, Gippsland Lakes; Schnapper Point (*McCoy*).

Tasmania: Table Cape! (*R. M. Johnston*).

South Australia: very common in the calciferous sandrock of the R. Murray Cliffs, near Morgan; in a well-sinking at the Nine-mile Camp, near Morgan; casts in the hard calciferous sandstones associated with the oyster banks at Aldinga and Adelaide (*R.T.*)

Cucullæa Adelaidensis, *spec. nov.* Pl. xi., fig. 14.

Shell obliquely trapezoidal, very tumid, inequilateral; umbones large, incurved, slightly in front; anterior margin rounded, ventral margin straight, oblique to the straight hinge line; posterior margin slightly undulating, obtusely truncated; posterior slope flattened, separated from the moderately convex rest of the valve by an obtusely rounded ridge extending from the umbo to the post-ventral margin. Surface ornamented with fine, narrow, radial riblets, not much wider than the impressed furrows, crossed by numerous close-set retroflexed laminæ of growth. In the umbonal region the transverse laminæ are wider apart, and at the intersections form granulations, but towards the front they are more crowded, and are raised on the riblets into squamæ. The radial riblets increase by bifurcation, and at the proximal end the duplication is indicated by a linear sulcus. Inner margin of the valves coarsely ridged. The ligamental area is marked with five impressed divaricating furrows. There are three or four anterior and four or five posterior longitudinal laminar teeth. The central teeth are small and transverse, and increase in size and obliquity outwards. The post-adductor muscular impression with a thickened, but not elevated, inner margin.

Dimensions of an average-sized specimen:—Length from antero-dorsal to post-ventral margin, 44; width from umbo to ventral margin, 29; thickness through both valves, 30.

Locality.—Many specimens obtained from the glauconitic sands, Adelaide bore.

This species closely resembles *C. Corioensis*, but may at a glance be distinguished by its more oblique outline and finer sculpture; also it is less tumid, the umbones not so wide, and the radial ribs are narrower and more numerous.

FAMILY TRIGONIIDÆ.

Genus Trigonia.

SYNOPSIS OF SPECIES.

Transversely ridged on the anterior two-thirds of the valves; posterior slope radially ridged.
- Ridges plain. *T. semiundulata.*
- Ridges with tubular projections. *T. tubulifera.*

Whole surface of valves radially ridged.
- Ribs acute with spinous tubercles. *T. acuticostata.*
- Ribs thick, anterior ones with blunt tuberculations. *T. Howitti.*

Trigonia semiundulata, McCoy.

References.—Geological Magazine, vol. 3, p. 481, and Pal. Victoria, Dec. II., pl. xix., figs. 4, 5.

Localities.—Victoria: very abundant in the sandy beds of Bird Rock Bluff, near Geelong (*McCoy*); Muddy Creek (*R.T.*); Tasmania: Table Cape! (*R. M. Johnston*); South Australia: silicified sandstone blocks in the sharp sands underlying the pebble bed at Gawler (*R. T.*). Also quoted by Hutton from the Pareora Series at Awamoa, New Zealand.

Trigonia tubulifera, Tate, Plate xi., figs. 13*a*—13*b*.

Reference.—Southern Science Record, January, 1885, p. 3.

Shell minute, quadrate; the flattish posterior area with about 16 thin radial ribs beset with truncate tubular projections; the remainder of the surface with about 20 concentric ribs similarly ornamented.

The tubular projections are short though conspicuous, and are separated one from the other by intervals not much wider than the tubes. Only two examples have occurred to me—one, a left valve, from Schnapper Point, on which the two areas are well-marked, the other, a right valve, from Muddy Creek, has the anterior area so masked by the long tubular projections as to conceal the concentric arrangement of the ribs.

Length and height, about 5 millimetres.

Trigonia acuticostata, McCoy.

References.—Geological Magazine, vol. 3, p. 482, and Pal. Victoria, Dec. II., pl. xix., figs. 1, 2.

Localities.—Muddy Creek and Mordialloc, Victoria (*McCoy*); oyster beds of the Upper Murravian at the North-west Bend Head Station, R. Murray, in South Australia (*R. T.*) Casts, probably of this species in beds of the same age at Tickera near Wallaroo, and at Aldinga.

It has been reported by Prof. McCoy (Ann. and Mag Nat. Hist., 1876, p. 273) living in Bass Straits.

Trigonia Howitti, McCoy.

Reference.—Palæontology of Victoria, Dec. III., pl. xxvii., figs. 1—2*c*, 1876.

Locality.—Sandy marl at Jemmy's Point, near the entrance of the Gippsland Lakes, collected by Mr. A. Howitt, after whom it is named.

FAMILY CRASSATELLIDÆ.

Genus Crassatella.

SYNOPSIS OF SPECIES.

A. Valves with plain margins.
- Elongate ovate-trigonal. *C. oblonga.*
- Subquadrate; fine concentric folds. *C. astartiformis.*
- Subquadrate; tumulous concentric ridges. *C. corrugata.*
- Subtriangular, anterior side very short, fine concentric folds. *C. abbreviata.*

B. Valves with crenated margins in the adult.
- Ovate-oblong; concentrically folded. *C. Dennanti.*
- Ovate-trigonal; nearly smooth. *C. aphrodina.*

Crassatella oblonga, *Tenison-Woods.*

Reference.—Proc. Roy. Soc., Tasm., for 1875, t. ii., fig. 11, p. 25.

Localities.—Tasmania: Table Cape! (*R. M. Johnston*). Victoria: Muddy Creek. South Australia: Oyster beds, North-West Bend, River Murray.

Very distinct from any existing species; is somewhat like *C. attenuata*, Hutton, of the Older Tertiary, New Zealand.

Crassatella Dennanti, *spec. nov.* Plate xi., fig. 2.

Shell ovate-oblong, moderately convex, inequilateral; umbones anterior; rounded in front, expanded, flattened, and obliquely truncated behind. Surface closely and irregularly concentrically folded, folds narrow, about as wide as the furrows, acutely rounded, minutely and regularly radially striated; the broad posterior flattened area is faintly marked by a median ridge, the lamellæ of growth in the form of thin imbricating plates. Lunule impressed lanceolate. Hinge area narrow; left valve with two cardinal teeth in front of the cartilage pit, and one lamellar tooth posteriorly; right valve with three cardinal teeth in front of the pit, the middle one very thick and crenulated on the side, the outer one small and marginal. Inner margin of valves denticulated.

Dimensions.—Length, 57; width, 37; thickness through both valves, 32 millimetres.

Locality.—Not rare Muddy Creek, Hamilton (*J. Dennant*).

This species, which is named after J. Dennant, Esq., Hamilton, in recognition of palæontological services rendered, has no immediate ally in recent creation, but it has some general resemblance to *C. Traillii*, Hutton, of the Older Tertiary of New Zealand, from which it differs by its truncated posterior margin and its concentric folds.

Crassatella aphrodina, Tenison-Woods.

Reference.—Proc. Roy. Soc., Tasm., for 1875, t. iii., fig. 12, p. 24.

"Ovate-trigonal, oblique solid, faintly striate and sulcate; umbones sharp, with more distinct sulci; lunule impressed; posterior side subangulate and produced. Long., 53; lat., 44 mills."

Localities.—Table Cape; Adelaide bore (fragments of hinge).

This species is related to *C. australis*, Hutton, of the New Zealand Tertiary.

Crassatella astartiformis, *spec. nov.* Pl. xi., figs. 12 and 15.

Shell subquadrate, slightly convex; umbones a little anterior; dorsal margin rather straight; posterior side roundly truncated, anterior side convex. Surface ornamented with concentric folds and minute, radial striæ; the folds are compressed, somewhat reflected, narrower than the furrows, more regular and stouter in the umbonal region.

Dimensions of a very large specimen:—Length, 20; width, 17; thickness through both valves, 8 millimetres.

Localities.—Very abundant of small size, Aldinga and Adelaide bore; rare, R. Murray Cliffs; Muddy Creek and Schnapper Point (*R.T.*).

Crassatella corrugata, *spec. nov.* Pl. ii., fig. 14.

Shell subquadrate, similar to *C. astartiformis*, but proportionately longer; surface with a few high angular corrugations, and striated between.

Dimensions.—Length, 6; width, 4·5 millimetres.

Locality.—Clays with *Turritella Aldingæ* at Blanche Point, Aldinga Bay.

Crassatella abbreviata, *spec. nov.* Pl. xi., fig. 16.

Shell subtriangular, elevated, compressed, inequilateral; umbones anterior, prominent; dorsal margin much sloped; anterior side very short; posterior margin roundly truncated. Surface ornamented with numerous narrow concentric folds. Inner margin of valves plain.

Dimensions.—Length, 8·5; width, 7·5; thickness through both valves, 3 millimetres.

Locality.—Calciferous sandstones, R. Murray Cliffs, near Morgan.

FAMILY ASTARTIDÆ.

Genus Micromeris, *Conrad.*

SYNOPSIS OF SPECIES.

Ornament of fimbriated, imbricating lamellæ.	*M. rugosa.*
Ornament of radial ridges and simple folds.	*M. radiata.*

Micromeris rugosa, *spec. nov.* **Plate x., fig. 11.**

Shell trigonal, compressed, with produced somewhat attenuated rather straight umbones, equilateral; anterior and posterior slopes straight, inclined at an acute angle; ventral margin rounded; inner margin of valves distantly crenulated. Lunule narrow, not deeply impressed. Surface crowded with thin imbricating lamellæ; the edges of the lamellæ varying from simple to thickly fimbriated, the fimbriations corresponding with rounded depressed radial riblets.

Dimensions.—Length, 3; width, 3·5 millimetres.

Locality.—Lower beds, Adelaide bore.

Micromeris radiata, *spec. nov.* **Plate x., fig. 12.**

Shell trigonal, slightly convex, with produced rather straight umbones, equilateral, ventrally rounded; inner margin of valves distantly crenulated. Surface smooth, shining, radially ribbed, and concentrically ridged or coarsely striated. Umbones in contact, bounded before and behind by a deep elliptical depression, angulated on the margin.

Dimensions.—Length, 4·5; width, 4·5; thickness through both valves, 2·5 millimetres.

Localities.—Very common in the lower beds, Blanche Point, Aldinga Bay, and Adelaide bore.

Gouldia lamellata, *spec. nov.* **Plate ii., fig. 17.**

Shell subtriangular to subquadrangular, compressed or moderately convex; umbones anterior, rather elevated and acute. Surface with about twenty thin, elevated, concentric lamellæ, and striæ of growth. Inner margin of valves with large, close crenulations. The shell differs in shape, in the amount of compression, and in the number of the lamellar folds; but one set of characters is not correlative with another set, so that the variations are individual, and not specific. The subquadrangular forms have a close resemblance to a *Chione*, allied to *Venus Allporti*, T. Woods, occurring in the same beds.

Dimensions.—Length, 5·5; width, 5 millimetres.

Localities.—Not uncommon in the lowest beds, Blanche Point, Aldinga, and Adelaide bore.

Genus Mytilicardia.

SYNOPSIS OF SPECIES.

Posterior side widened; ribs 21.	*M. alata.*
Posterior side narrowed; ribs narrow, 15.	*M. compta.*
Posterior side narrowed; ribs broad, 12.	*M. platycostata.*
Shell trapeziform, uniformly ribbed.	*M. curta.*

Mytilicardia alata, *spec. nov.* Plate ii., fig. 12.

Shell ovately-oblong, somewhat depressed; anterior side very short, truncated; widely rounded and compressed posteriorly; ventral margin nearly straight, inconspicuously sinuated.

Surface radially ribbed, with lamellar or spiny projecting scales, and undulating concentric lines of growth. Four ribs of large dimensions occupy the ridge extending from the umbo to the post-ventral angle; these are broad, rounded, not much elevated, rather abruptly narrowed to form a surmounting rib, which carries the distant spiny scales. The anterior ribs are twelve in number, densely covered with scaly spines. The posterior ridge is succeeded by a broad space with two flat ribs, posterior to which are three compressed ribs with imbricating spinous scales. Inner margin of valves coarsely crenulate.

Dimensions.—Length, 25; greatest width, 20; width at umbo, 12 millimetres.

Locality.—Adelaide bore.

This species is distinguished from *M. crassicostata*, and allied species possessing lamellar scales on the ribs, especially by its wing-like posterior slope; in the longitudinal constriction of the primary ribs it resembles *M. Novæ Hollandiæ*, Deshayes.

Mytilicardia compta, *spec. nov.* Plate xii., fig. 2.

Shell elongately ovate, somewhat depressed; ventral margin inconspicuously sinuated, in other respects similar to *M. crassicostata*, Lamk. There are four primary subangulated ribs, posterior to which are two narrow ribs succeeded by two compressed elevated ribs; the anterior ribs are seven in number. All the ribs are more or less raised into lamellar scales.

Dimensions.—Length, 29; greatest width, 17; width at umbo, 12 millimetres.

Localities.—Muddy Creek; oyster banks at North-west Bend Head Station, on the River Murray.

This species differs from *M. crassicostata* by its narrower shape, depressed umbones, and subacute ridges, and by the absence of a subanterior contraction ventrally.

Mytilicardia platycostata, R. M. Johnston.

Reference.—Proc. Roy. Soc. Tasm. for 1879, p. 40.

"Shell oblong ovate, ornamented with twelve broad slightly-raised squamose radiating ribs, surmounted by a smaller ridge of distant lamellose spines; breadth of interspaces and rays equal; rays finer and closer together as they approach the slope. Long., 50 mil.; lat., 35 mil.; alt. (both valves), 26 mil. Rare, Table Cape." R. M. Johnston.

Mytilicardia curta, *spec. nov.* Pl. ii., fig. 9.

Shell trapeziform, anteriorly very short, extremely gibbous; ventral margin straight, with a slight insinuation anteriorly; posterior margin roundly truncated; roundly elevated diagonally from the umbo, the posterior and dorsal portion somewhat dilated and convex; the ventral side is comparatively narrow and precipitous. Surface ornamented with 22 narrow, rather compressed, scaly, radial ribs; interstitial spaces slightly narrower than the ribs, marked with regular transverse liræ; margin of valves coarsely crenulated.

Dimensions.—Length, 13; greatest width towards the posterior margin, 11; width through the umbo, 8; thickness through both valves, 11 millimetres.

Locality.—Adelaide bore.

This species, which has a general resemblance to *Cardita trapezia*, Bruguiere, makes through *C. scabrosa*, mihi, an approach to the genus *Cardita*.

Genus Cardita.

SYNOPSIS OF SPECIES.

Triangular; ribs, 15, granose. *C. trigonalis.*
Ovate-triangular; ribs, 22, thin. *C. pecten.*
Rotund; ribs, 24, granose, linear interspaces. *C. compacta.*
Ovate-quadrate; ribs, 20, thick, crenulated. *C. Murrayana.*
Oval-subquadrate; ribs, 30, with erect scales. *C. scabrosa.*
Rotundly heart-shaped; ribs, 22, spinosely serrated. *C. spinulosa.*
Roundly oblong; ribs, about 30, with lamellar scales. *C. gracilicostata.*
id., widened posteriorly. *C. latissima.*
id., narrowed anteriorly; ribs, 37. *C. polynema.*
Roundly oblong; ribs, less than 30, with granulations.
Ribs, 26; fine granulations. *C. delicatula.*
Ribs, 22; coarse granulations. *C. Tasmanica.*

Cardita trigonalis, *spec. nov.* Pl. ii., fig. 1.

Shell triangular, moderately convex; umbones elevated, slightly oblique, incurved, anterior; posterior margin inclined, making with the slightly arched ventral margin a roundly acute angle; anterior side rounded; dorsally excavated. Surface ornamented with 15 crenately-nodulose, rounded, radiating ribs, the interspaces wider than the ribs with transverse thick liræ. Inner margin of valves coarsely crenulated.

Dimensions.—Length, 7; width, 6·5 millimetres.

Locality.—Oyster banks, Blanche Point, Aldinga Bay.

Cardita pecten, *spec. nov.* Plate ii., fig. 11.

Shell ovately triangular, transverse, rather depressed, regularly convex, except the flattened posterior slope; umbones small, acute, antemedian, directed forwards; anterior margin rounded, posterior obliquely truncated. Inner margin of valves coarsely crenulated. Surface ornamented with 22 narrow, compressed, crenately-granose, radial ribs; interspaces flat, wider than the ribs.

Dimensions.—Length, 6·5; width, 2; length from umbo to posterior angle, 6·5; thickness through both valves, 3 millimetres.

Localities.—Muddy Creek; Oyster-beds, North-West Bend of the River Murray.

Cardita compacta, *spec. nov.* Plate ii., fig. 13.

Shell minute, rotund, subglobose, subequilateral; umbones prominent, obtuse, incurved, approximate. Surface ornamented with 24 crenately-granose ribs separated by linear interspaces. Inner margin of valves crenately-serrated.

Dimensions.—Length, 5; width, 4·5; thickness through both valves, 3·5 millimetres,

Locality.—Muddy Creek.

This little shell resembles in ornamentation *C. scalaris*, Sow., recent north-west coast of America, and fossil in the English Crags; and *C. amabilis*, Deshayes, living off the coast of Tasmania, from both of which it differs in shape. It has some affinity to *C. parva*, Lea of the Claiborne-Eocene.

Cardita Murrayana, *spec. nov.* Plate ii., fig. 2.

Shell ovate-quadrate, moderately inflated, inequilateral; umbo anterior, broad, oblique, incurved; posterior side produced and flattened; radiately ribbed. Ribs 20, broad, rounded, elevated, crenulated; interspaces concave, about as wide as the ribs.

Dimensions.—Length, 35; width, 29; thickness through both

valves, 26; length of anterior side, 8; from umbo to post-ventral angle, 35 millimetres.

Locality.—Calciferous sandstone, Glenforslan, near Blanchetown, on the River Murray.

This species has some affinity to *C. spinulosa*, but is more produced and less inflated, and has a different ornament; among recent species it has the shape and number of ribs of *C. angisulcata*, Reeve, but in that shell the ribs are flat, broad, and close together.

Cardita scabrosa, *spec. nov.* Pl. ii., fig. 4.

Shell oval-subquadrate, anterior side very short, moderately convex; umbones anterior, incurved; posterior margin abruptly truncated; posterior side slightly dilated and flattened; inner margin of valves coarsely crenulated. Surface ornamented with 30 narrow compressed radial ribs, about as wide, or not quite so wide, as the interspaces; ribs densely covered with erect scales, which are somewhat spathulate, except on the posterior slope where they are somewhat oblong.

Dimensions.—Length, 21; width, 16; thickness through both valves, 12 millimetres.

Localities.—Calciferous sandrock of the River Murray Cliffs, near Morgan; Muddy Creek; Corio Bay.

Cardita gracilicostata, Tenison-Woods. Pl. ii., figs. 6 and 8.

Reference.—Proc. Roy. Soc., Tasm., for 1876, p. 112 (1877).

Shell roundly-oblong, transverse, inequilateral, moderately inflated; umbones anterior, oblique, much incurved. Surface ornamented with transverse raised liræ, and about 30 curved, radiating ribs, narrower than the concave interspaces; the ribs are laterally compressed, obsoletely nodular in the adult, except the anterior and posterior slopes, where the nodulations become less rounded and more lamellose. In young shells the ribs are densely beset with thick imbricating scales, somewhat spinous on the posterior slope, and granulose on the anterior side; minutely granular in the interspaces. Inner margin of valves coarsely crenulated; lunule short cordate, well defined and deep.

Dimensions of a large specimen:—Length, 35; of posterior side, 25; width, 31; thickness through both valves, 20 millimetres.

Locality.—Table Cape, Tasmania! (*R. M. Johnston*).

Of the many recent and fossil species with which I have compared *C. gracilicostata*, *C. acuticostata*, Lamarck, of the Anglo-Parisian Eocene basin, is the only one to which it bears any resemblance; from that species it differs in being less orbicular and in its simple ribs.

Cardita latissima, *spec.nov.* Pl. x., fig. 5.

Shell quadrately orbicular, very inequilateral, inflated; umbones near the front, oblique, incurved; anterior side short, rounded; acutely-roundly truncated and compressed posteriorly; ventral margin regularly arched. Surface with about 30 fine laterally compressed scaly ribs, much narrower than the flattish transversely striated interspaces. The ribs are densely beset with erect lamellar scales, becoming somewhat spinous on the posterior slope and thick on the anterior area. Lunule short, cordate, shallow; inner margin of valves coarsely crenulated.

In very young shells the ribs are much fewer, granulated, but spinose on the posterior slope.

Dimensions.—Length, 31; of posterior side, 23; width, 29; thickness through both valves, 20 millimetres.

Localities.—Very abundant Adelaide bore, and Blanche Point, Aldinga Bay.

This species in its ornamentation is similar to the young of *C. gracilicostata*, but the shape is very different; it is less globose than the recent *C. abyssicola*, Hinds, but the sculpture is different.

Cardita spinulosa, *spec. nov.* Pl. ii., fig. 3.

Shell rotundately heart-shaped, inflated, inequilateral; umbo anterior, oblique, incurved; radiately ribbed. Ribs, 22; spinosely serrated, very narrow, laterally compressed; interspaces wide, densely and irregularly lamellosely wrinkled; in the umbonal region the interspaces and the ribs are minutely granular. Inner margin of valves coarsely crenulated.

Dimensions.—Length, 33; width, 31; length of anterior side, 9; thickness through both valves, 36 millimetres.

Locality.—Blue clays, Schnapper Point, Hobson's Bay.

Cardita polynema, *spec. nov.* Plate ii., fig. 7.

Shell roundly-oblong, transverse, moderately inflated; umbones anterior, oblique, incurved; anterior side very short.

Surface ornamented with 37 narrow compressed radial ribs, about as wide as the interspaces; ribs densely covered with erect oval scales, except on the posterior and anterior slopes where they are somewhat spinous.

Dimensions.—Length, 18; width, 15·5; thickness through both valves, 11 millimetres.

Locality.—Schnapper Point, Port Phillip.

This species agrees in shape with *C. gracilicostata*, though less produced anteriorly, but has more numerous and closer ribs; it is somewhat intermediate between that species and *C. scabrosa.*

Cardita delicatula, *spec. nov.* Plate ii., fig. 10.

Shell roundly-oblong, rather depressed; umbones anterior oblique, incurved; posterior margin roundly truncated.

Surface ornamented with 26 compressed radial ribs, densely beset with granules passing into scales on the posterior slope; interspaces a little wider than the ribs. Inner margins of valves coarsely crenulated.

Dimensions.—Length, 11; width, 10; thickness through both valves, 6 millimetres.

Localities.—Common in the calciferous sandrock of the River Murray Cliffs, near Morgan; Muddy Creek; Schnapper Point

With the general form of *C. gracilicostata* this species is distinguished by its fewer and granular ribs.

Cardita Tasmanica, *spec. nov.* Plate xii., fig. 13.

Shell thick, roundly oblong, rather depressed; umbones prominent, oblique, incurved; anterior side very short.

Surface ornamented with 22 thickish, elevated, densely crenately-nodose, radiating ribs; interspaces a little wider than ribs, moderately concave, transversely wrinkled. Inner margin of valves coarsely crenulated.

Dimensions.—Length, 16; width, 14; thickness through both valves, 9 millimetres.

Locality.—Table Cape! (*R. M. Johnston*).

This species comes very near *C. delicatula*, but it has fewer ribs, which are thicker and coarsely ornamented; it has much resemblance to *C. rotunda*, Lea. of the Claiborne-Eocene, but that species has thin, elevated, scaly ribs.

Explanation of Plates.

N.B.—The figures are of the natural sizes, except when otherwise stated.

Plate II.

1. Cardita trigonalis, *Tate.* Enlarged.
2. Cardita Murrayana, *Tate.*
3. Cardita spinulosa, *Tate.*
4. Cardita scabrosa, *Tate.* R. Murray Cliffs.
5. Cardita latissima, *Tate.*
6. Cardita gracilicostata, *T. Woods.*
7. Cardita polynema, *Tate.*
8. Cardita gracilicostata, *T. Woods.* A young example.
9. Mytilicardia curta, *Tate.*
10. Cardita delicatula, *Tate.* R. Murray Cliffs.
11. Cardita pecten, *Tate.* Enlarged. Muddy Creek.
12. Mytilicardia alata, *Tate.*
13. Cardita compacta, *Tate.*

14. Crassatella corrugata, *Tate*. Enlarged.
15. Barbatia consutilis, *Tate*.
16. Barbatia crustata, *Tate*. Enlarged.
17. Gouldia lamellata, *Tate*. Much enlarged.

Plate III.

1. Lima linguliformis, *Tate*. Muddy Creek. *a*, Natural size ; *b*, magnified portion near the front.
2. Pecten subbifrons, *Tate*. Adelaide.
3. Vulsella lævigata, *Tate*. *a*, Exterior view, natural size; *b*, hinge-line, enlarged.
4. Modiolaria Corioensis, *Tate*. Much enlarged.
5. Modiolaria subgranosa, *Tate*. Much enlarged.
6. Pecten consobrinus, *Tate*. Aldinga.
7. Modiolaria singularis, *Tate*. Much enlarged.
8. Limea alticostata, *Tate*. Much enlarged.
9. Dimya dissimilis, *Tate*. Slightly enlarged. Muddy Creek. *a*, Exterior view of attached valve ; *b*, interior view of the same ; *c*, exterior of free valve.

Plate IV.

1. Ostrea hippopus, *Tate*. *a*, View from above ; *b*, side view.
2. Nucula Morundiana, *Tate*. *a*, End view ; *b*, seen from above ; both enlarged ; *c*, magnified view of surface.
3. Nucula Atkinsoni, *R. M. Johnston*. River Murray Cliffs. *a*, View from above ; *b*, end view ; both natural sizes ; *c*, magnified view of surface.
4. Nucula fenestralis, *Tate*. Much enlarged.
5. Nucula semistriata, *Tate*. *a* and *b*, Much enlarged views.
6. Pecten spondyloides, *Tate*. A small example. Aldinga Cliffs.
7. Pecten spondyloides. Variety from Mannum.
8. Lima (Limatula) Jeffreysiana, *Tate*. River Murray Cliffs.

Plate V.

1. Placunanomia sella, *Tate*. River Murray Cliffs. *a*, Attached valve ; *b*, exterior view of foramen with the shell broken away, showing the margin of the plug-sheath ; *c*, interior view, showing plug-sheath.
2. Leda planiuscula, *Tate*. Natural size in outline, and much enlarged view.
3. Leda obolella, *Tate*. Natural size in outline ; *a* and *b*, exterior and umbonal aspect, enlarged. Muddy Creek.
4. Pecten palmipes, *Tate*. Left valve. Edithburg.
5. Leda crebricostata, *T. Woods*. Natural size in outline ; *a* and *b*, exterior and umbonal aspect, much enlarged.

6. Leda acinaciformis, *Tate.* Natural size in outline; *a* and *b*, exterior and umbonal aspects, enlarged.
7. Placunanomia Ione, *Gray.* 7*a*, Interior view of free valve; *a*, the cartilage furrow; *b*, muscular impression; *c*, adductor impression; 7*b*, exterior view of free valve.
8. Lima Bassii, *T. Woods.* River Murray Cliffs. *a*, Natural size; *b*, enlarged view of ornament.

Plate VI.

1. Ostrea Sturtiana, *Tate.* Overland Corner.
2. Gryphæa tarda, *Hutton.* *a*, Side view of attached valve; *b*, free valve seen from above. Great Australian Bight.
3. Rhynchonella Baileyana, *Tate.* *a*, Seen from above; *b*, front view; *c*, side view.
4. Leda Huttoni, *T. Woods.* Aldinga.
5. Ostrea hyotis, *Linn.* Blanchetown.
6. Nucula tumida, *T. Woods.* *a* and *b*, Front and side views. Muddy Creek.
7. Leda lucida, *T. Woods.* *a* and *b*, Front and umbonal aspects of an adult example. Near Morgan.

Plate VII.

1. Pecten Aldingensis, *Tate.* *a* and *b*, Right and left valves; *c*, ornamentation much enlarged.
2. Pecten Sturtianus, *Tate.* *a* and *b*, Left and right valves; *c*, ornamentation much enlarged. R. Murray Cliffs.
3. Pecten Zitteli, *Hutton.* *a*, Right valve; *b*, left valve; *c*, interior of left valve; enlarged views. Muddy Creek.
4. Pecten palmipes, *Tate.* *a*, Right valve; *b*, enlarged view of an interstitial space.
5. Pecten Murrayanus, *Tate,* *a* and *b*, Right and left valves. R. Murray Cliffs.

Plate VIII.

1. Lima Bassii, *T. Woods.* *var.* Adelaide bore. *a*, nat. size; *b*, Hinge area enlarged; *c*, magnified ornament.
2. Pecten polymorphoides, *Zittel.* R. Murray Cliffs.
3. Pecten Eyrei, *Tate.* Aldinga.
4. Lima polyactina, *Tate.* *a* and *c*, Interior and exterior views, enlarged; *b*, magnified portion of exterior.
5. Limarca angustifrons, *Tate.* *a*, Exterior enlarged; *b*, hinge area much enlarged.
6. Pecten Eyrei, *Tate.* Scaly ornament of, slightly enlarged.
7. Pecten Flindersi, *Tate.* *var.* Aldinga.
8. Dimya sigillata, *Tate.* *a*, Interior; *b*, exterior of attached valve, enlarged.

Plate IX.

1. Septifer fenestratus, *Tate.*
2. Modiolaria arcacea, *Tate.*
3. Pecten dichotomalis, *Tate.* *a* and *b*, Right and left valves; *c*, magnified view of portion of surface.
4. Leda apiculata, *Tate.* *a* and *b*, Enlarged views. Aldinga.
5. Anomia cymbula, *Tate.* Slightly enlarged.
6. Limea transenna, *Tate.* *a*, Enlarged; *b*, magnified ornamentation.
7. Pecten antiaustralis, *Tate.* *a*, Natural size; *b*, portion of surface near the front; *c*, in the umbonal region, magnified.
8. Leda Woodsii, *Tate.* Adult example enlarged.
9. Meleagrina crassicardia, *Tate.* Young example. Muddy Creek.
10. Meleagrina crassicardia, *Tate.* Cardinal area of an adult. North-West Bend of the River Murray.

Plate X.

1. Pecten Peroni, *Tate.* *a*, Natural size; *b*, sculpture, magnified. Aldinga.
2. Barbatia limatella, *Tate.* Adelaide.
3. Crenella globularis, *Tate.* *a* and *b*, Much enlarged. Adelaide.
4. Macrodon Cainozoicus, *Tate.* *a*, Natural size; *b*, enlarged hinge-line; *c*, magnified ornament. Muddy Creek.
5. Leda leptorhyncha, *Tate.* *a* and *b*, Enlarged views. Adelaide.
6. Ostrea arenicola, *Tate.* Aldinga.
7. Barbatia pumila, *Tate.* Slightly enlarged. Muddy Creek.
8. Petunculus Cainozoicus, *T. Woods* Variety from Muddy Creek; *a* and *b*, front and umbonal aspects.
9. Lima (Limatula) polynema, *Tate.* Slightly enlarged.
10. Barbatia celleporacea, *Tate.* *a* and *b*, Front and umbonal aspects. Schnapper Point.
11. Micromeris rugosa, *Tate.* Slightly enlarged. Adelaide.
12. Micromeris radiata, *Tate.* *a* and *b*, Front and umbonal aspects, enlarged.

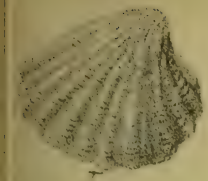
Plate XI.

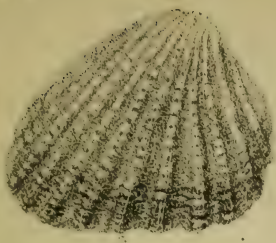
1. Pectunculus lenticularis, *Tate.* Adelaide.
2. Crassatella Dennanti, *Tate.* Muddy Creek.
3. Modiola Adelaidensis, *Tate.* Adelaide.
4. Barbatia dissimilis, *Tate.* Left valve, slightly enlarged. Adelaide bore.
5. Barbatia dissimilis, *Tate.* Right valve, slightly enlarged. Adelaide bore.

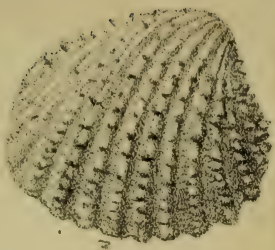
6. Petunculus subtrigonalis, *Tate.* *a* and *b*, Exterior and interior aspects. River Murray cliffs.
7. Petunculus convexus, *Tate.* *a* and *b*, Umbonal and front aspects. Muddy Creek.
8. Arca pseudonavicularis, *Tate.* *a* and *b*, Front and umbonal aspects. Adelaide bore.
9. Arca equidens, *Tate.* Much enlarged. Adelaide bore.
10. Barbatia simulans, *Tate.* Muddy Creek.
11. Avicula nasuta, *Tate.*
12. Crassatella astartiformis, *Tate.*
13. Trigonia tubulifera, *Tate.* *a*, Enlarged; *b*, magnified ornament. Muddy Creek.
14. Cucullæa Adelaidensis, *Tate.* *a*, Natural size; *b*, enlarged ornament.
15. Crassatella astartiformis, *Tate.* Young example.
16. Crassatella abbreviata, *Tate.* Slightly enlarged. River Murray cliffs.

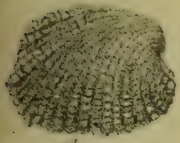
Plate XII.

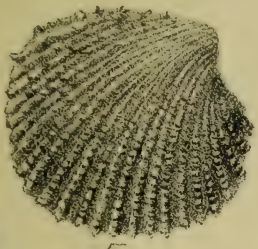
1. Limopsis multiradiata, *Tate.* *a*, Enlarged view of valve; *b*, surface near the front, magnified.
2. Mytilicardia compta, *Tate.* Muddy Creek.
3. Lucina dentata, *Wood.* North-West Bend.
4. Leda prælonga, *Tate.* *a* and *b*, Front and umbonal aspects, much enlarged. Muddy Creek.
5. Lucina fabuloides, *Tate.* Enlarged.
6. Lucina projecta, *Tate.* Muddy Creek.
7. Lucina leucomomorpha, *Tate.* *a* and *b*, Front and umbonal aspects. Muddy Creek.
8. Saxicava australis, *Lamarck.* Adelaide bore.
9. Pinna semicostata, *Tate.*
10. Lucina nuciformis, *Tate.* *a* and *b*, Front and umbonal aspects, much enlarged.
11. Lucina planatella, *Tate.* Table Cape.
12. Avicula nasuta, *Tate.* Fragment of right valve, with the anterior wing complete.
13. Cardita Tasmanica, *Tate.*
14. Cardium cuculloides, *Tate.* *a* and *b*, front and umbonal aspects. Muddy Creek.

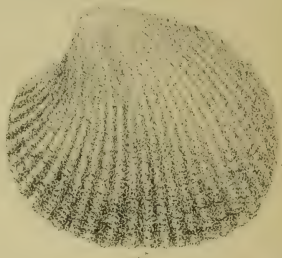

1

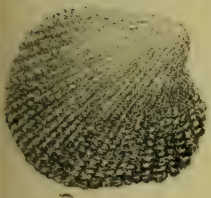

2

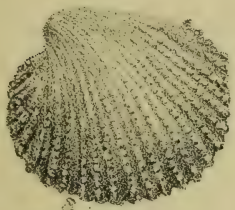

3

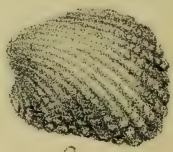

4

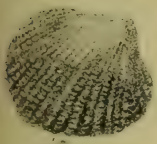

5

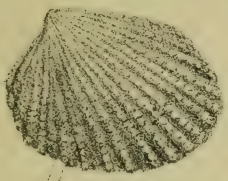

6

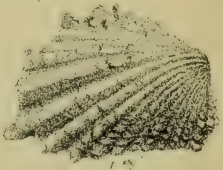

7


8


9

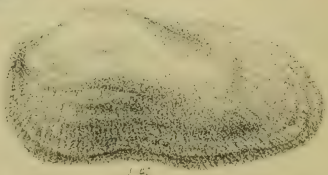

10

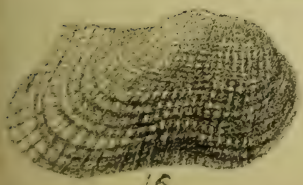

11


12

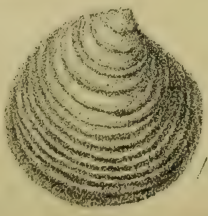
13

14

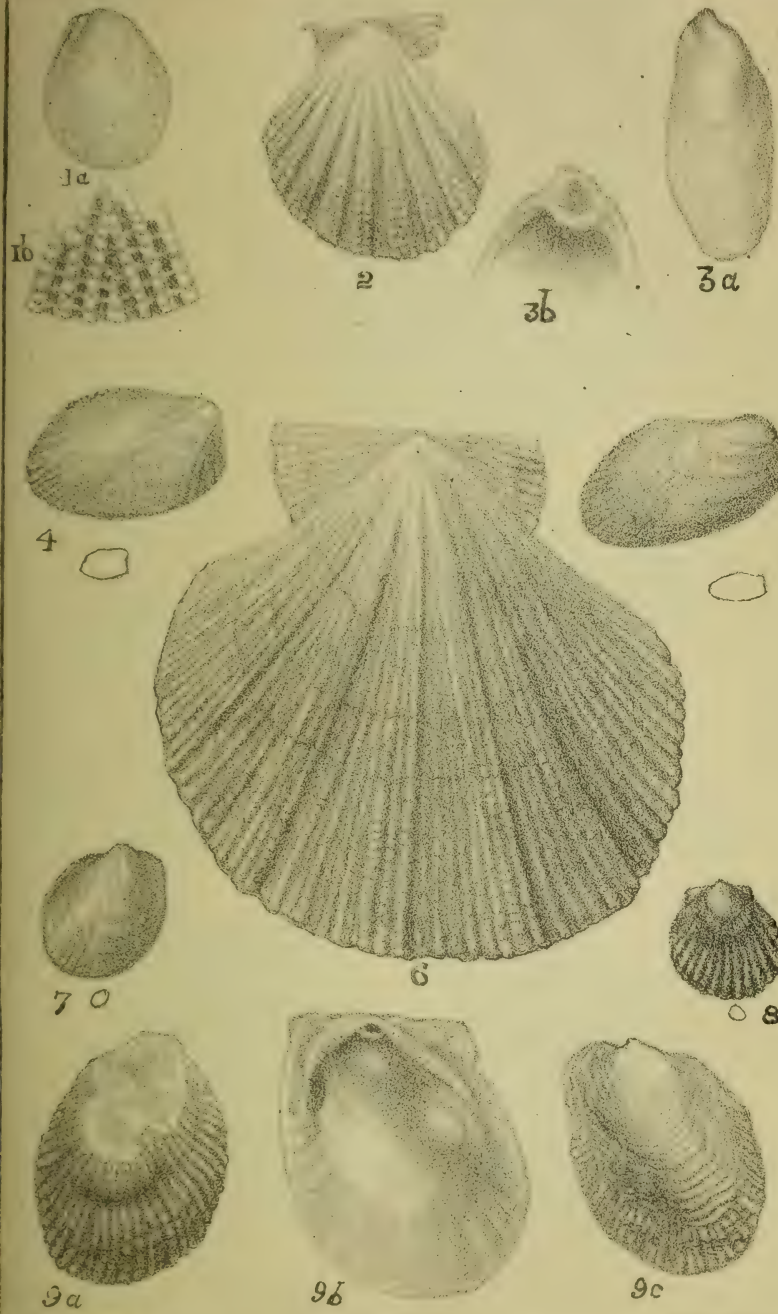

15


16

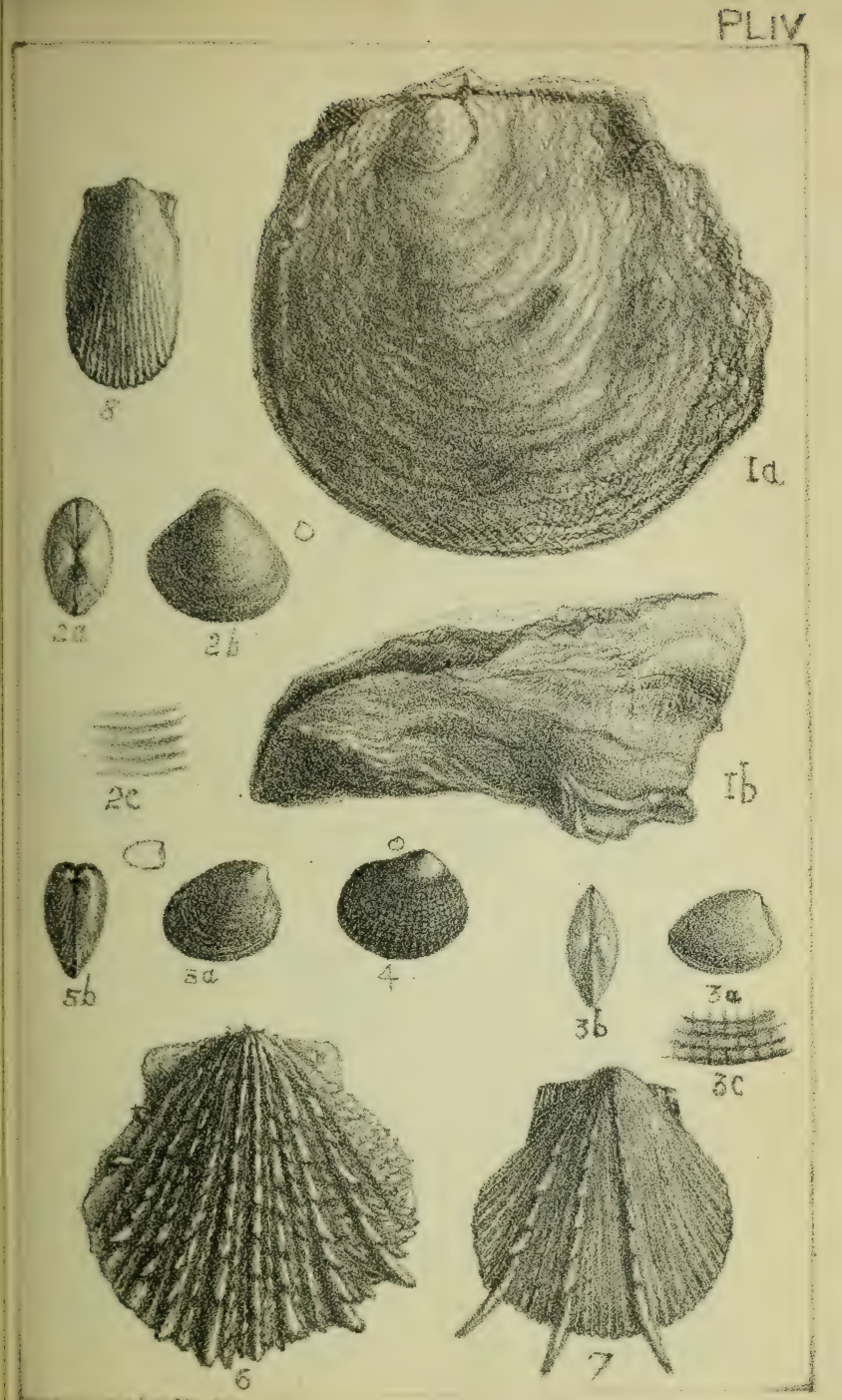
17b


17a

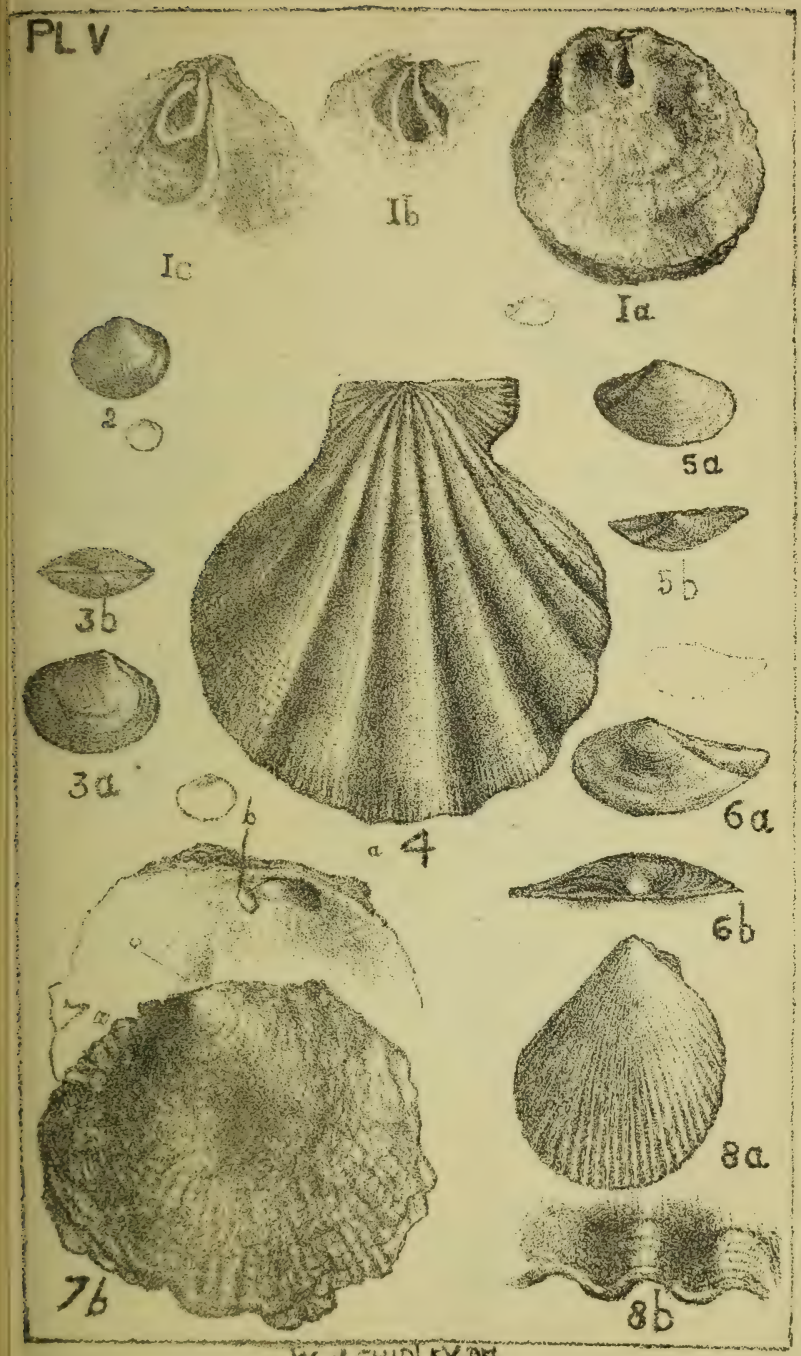
W. & C. HINDLEY & SON



W.J.CHIDLEY. DEL.

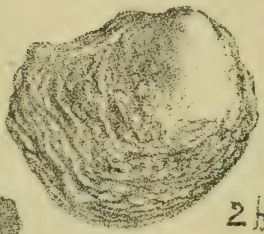


W.L. SHIDLEY Del.

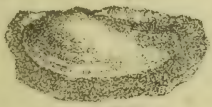

PL V
Ic
Ib
Ia
2
5a
5b
3b
3a
4
a
b
6a
6b
7b
8a
8b
W. J. CHIDLEY DEL.

1

2a



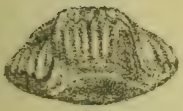
2b



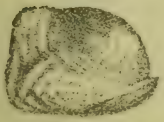
4

3a

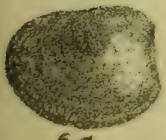
5



3b

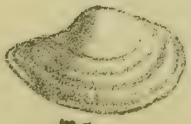


3c



6a

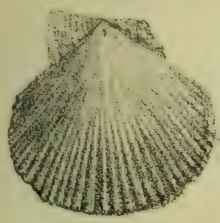
6b



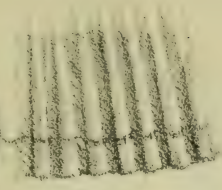
7a

7b

V. J. CHIOLE Y. DEL.



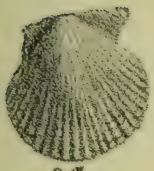
1a



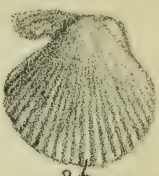
1c

1b

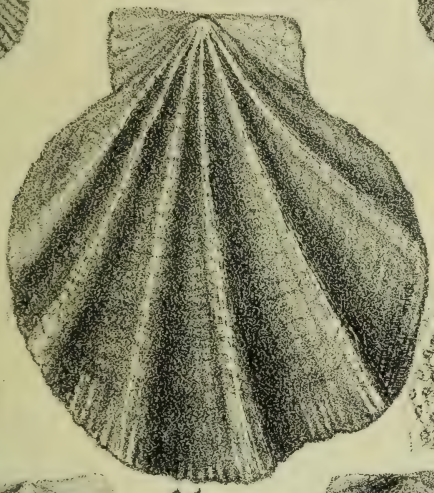
3a



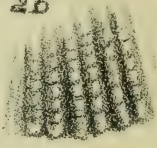
2a



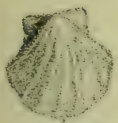
2b



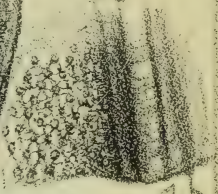
4a



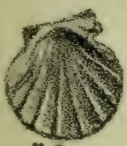
2c



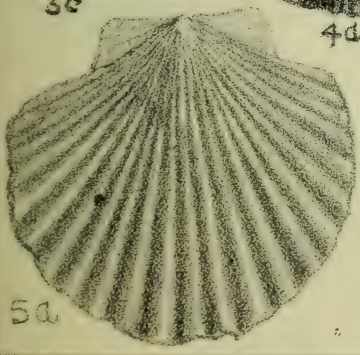
3b



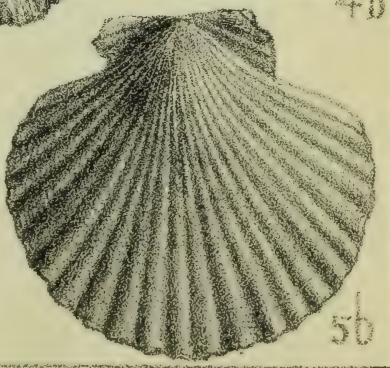
4b



3c



5a

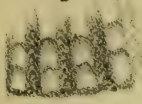


5b

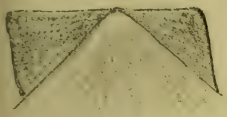
W. CHIDLEY DEL.

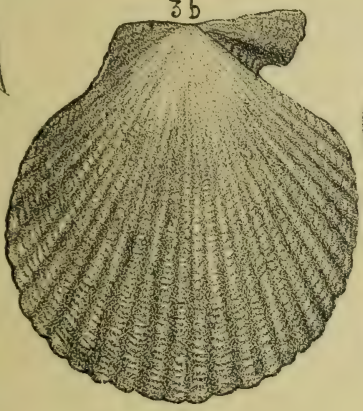
Ia

Ib


Ic

2


3a

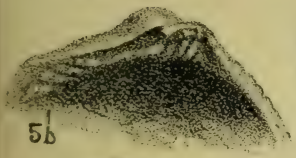

3b

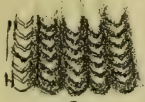
4a

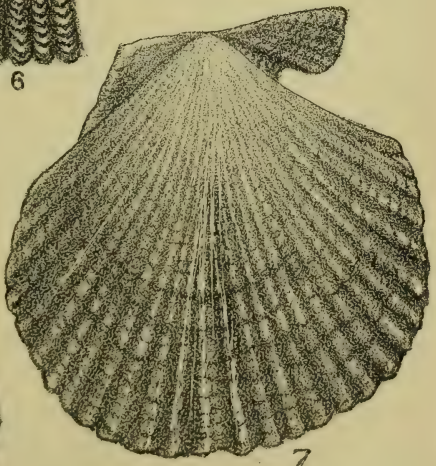
4b

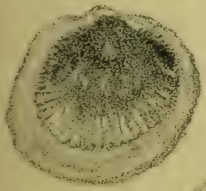
4c

5a


5b

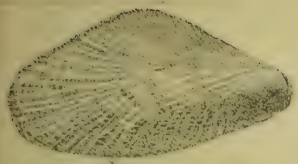

6


7


8a

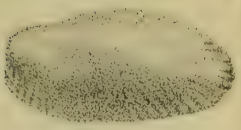
8b

W J CHIBLEY DEL

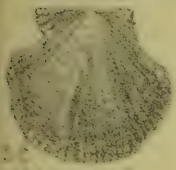


1

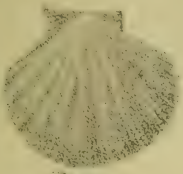
2b



2a

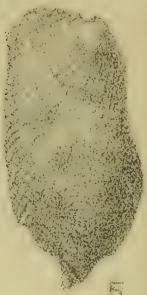


3c

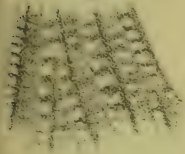


3a

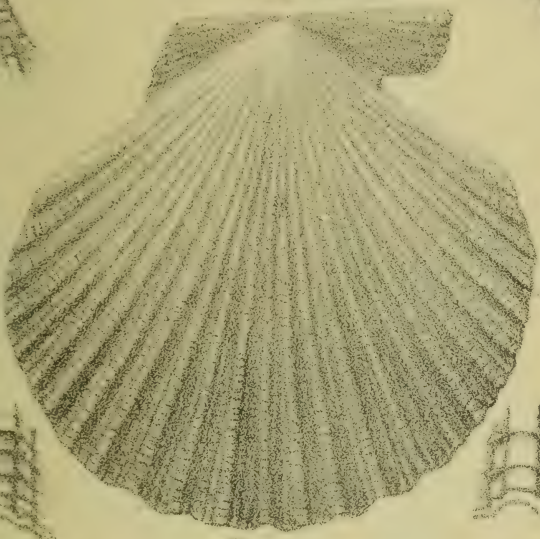
4



5

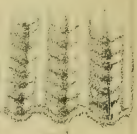


6c

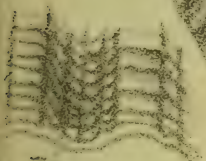


7a

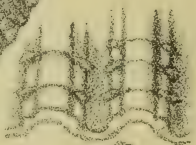
6a



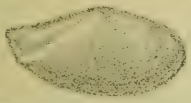
6b



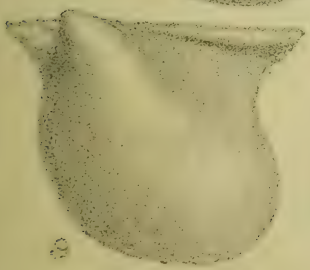
7c



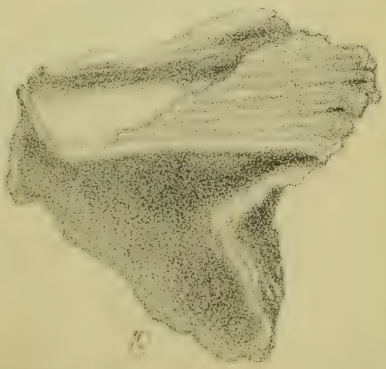
7c



8

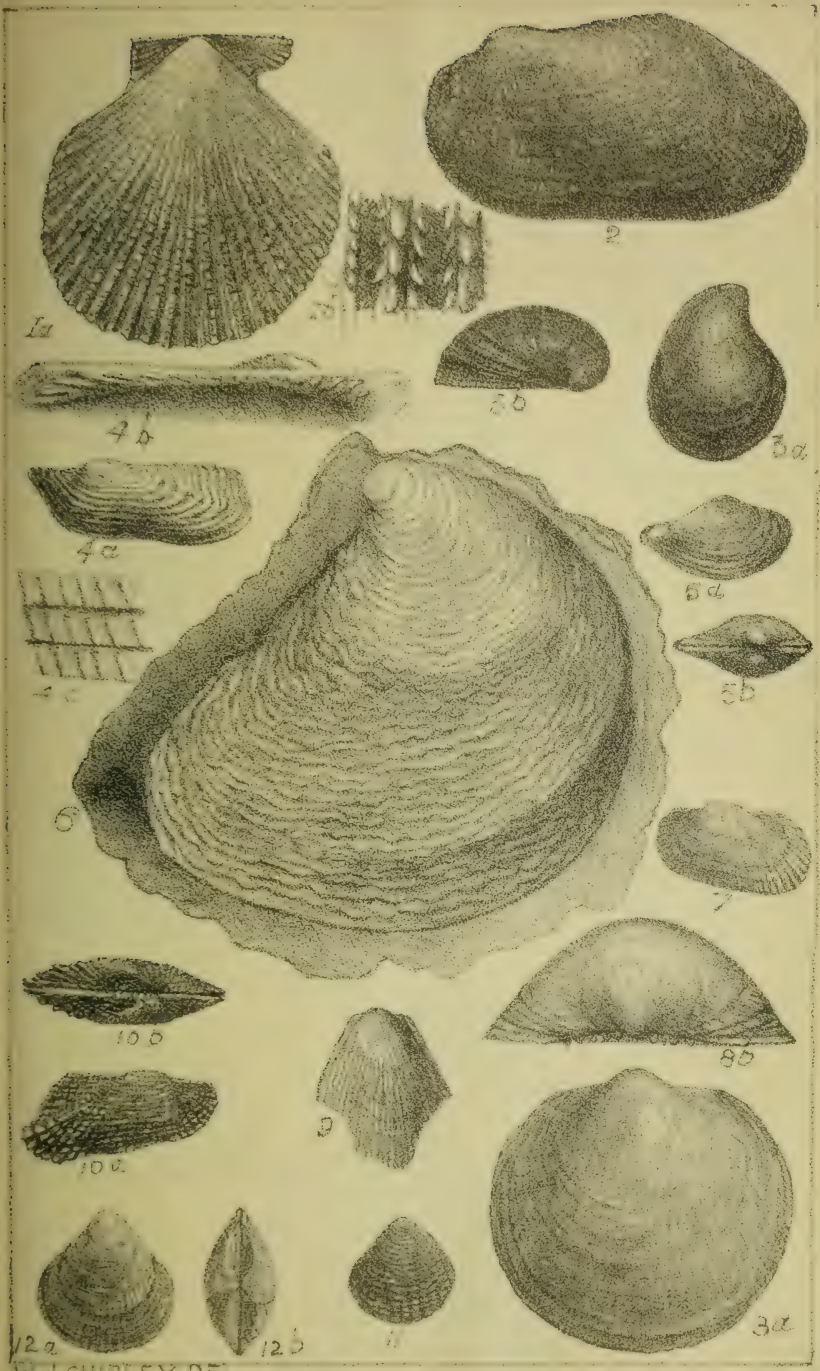


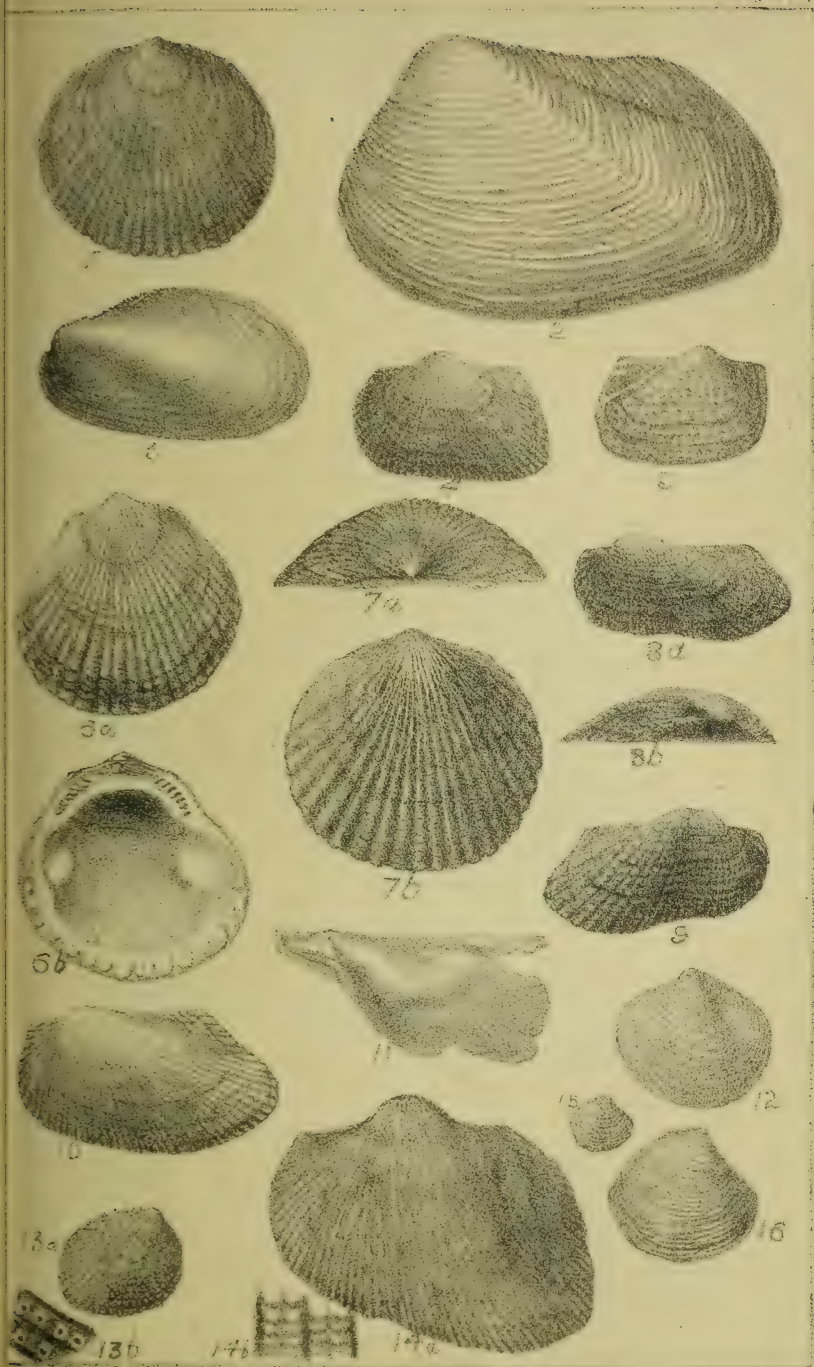
9



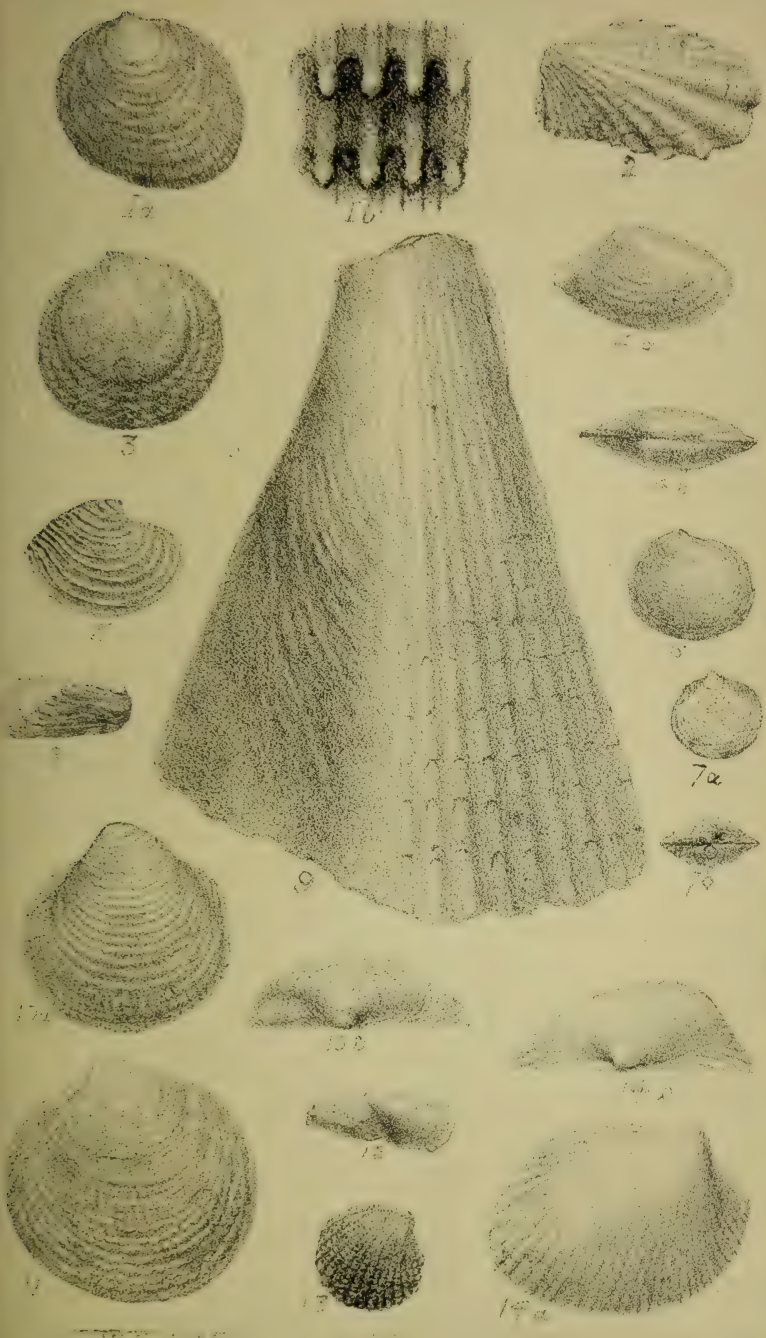
10

W.H.CHIDLEY. DEL


1a
2
4b
3b
3a
4a
4c
6
5a
5b
7
10b
8b
9
10a
12a
12b
11
3a
W.J.CHIDLEY DEL



W.J.CHIDLEY DEL



MISCELLANEA.

———o———

The Dasyurus a (?) Vegetarian.

On Friday, January 30, 1885, I saw Mr. F. H. Edwards, lessee of the late Mr. George S. Kingston's estate at Marino, and he informed me (and Messrs. George Laughton and J. T. Fickling) that he had missed a great number of peaches from some of the trees in the garden, and, suspecting that opossums were destroying the fruit, he had some steel traps set beneath the trees. The next morning after setting them his sons brought in a native spotted cat (Dasyurus), which he (Mr. Edwards) opened and examined, and was surprised to find its maw filled with masticated peach-pulp. He afterwards examined others caught in the same manner, and always found the pulp in their stomachs. This being a new fact in natural history has been considered worthy of mention before this Society. The two gentlemen who were with me are intimate with Mr. Edwards, and vouch for the reliability of his statements.

A. Molineux.

———

Fungi Collected by J. G. O. Tepper about Clarendon, 1882-3.

Identified by Dr. Cooke from specimens sent, viz :—

Agaricus sobrius, *Fries.*
" umbelliformis, *Fr.*
" spumosus, *Fr.*
" quilinus *Fr.*
" tener, *Fr.*
" pediades, *Fr.* (or nearly related species).
" faxiculatus.
Polyporus oblectans, *Berkeley.*
Secotium coarctatum, *Berk.*
Hygrophorus ceraceus, *Fries.*
Clavaria rugosa, *Fr.*
Dacrymyces, sp.

The above are addenda to a list published in the Society's Transactions, vol. vi., p. 68.

List of Plants Collected by Chas. Winnecke, near Stuart's Range in 1885.

By Baron von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

Ranunculus parviflorus, *Linné.*
Lepidium phlebopetalum, *F. v. M.*
" papillosum, *F. v. M.*
Zygophyllum fruticulosum, *Candolle.*
Plagianthus glomeratus, *Bentham.*
Frankenia lævis, *L.* (several varieties).
Polycnemum diandrum, *F. v. M.*
Ptilotus obovatus, *F. v. M.*
Pimelea simplex, *F. v. M.*
Loranthus pendulus, *Sieber.*
Aster Muelleri, *Sonder.*
Minuria leptophylla, *Candolle.*
Calotis plumulifera, *F. v. M.*
Ixiolæna leptolepis, *Bentham.*
Gnephosis arachnoidea, *Turczaninow.*
Chthonocephalus Pseudevax, *Steetz.*
Angianthus pusillus, *Bentham.*
Podolepis Siemsieni, *F. v. M.*
" canescens, *Cunningham.*
Helipterum pterochætum, *Bentham.*
" moschatum, *Bentham.*
" floribundum, *Candolle.*
" strictum, *Bentham.*
Isotoma petræa, *F. v. M.*
Plantago varia, *R. Brown.*
Nicotiana suaveolens, *Lehmann.*
Dæmia Kempeana, *F. v. M.*
Convolvulus erubescens, *Sims.*
Eremophila scoparia, *F. v. M.*
" Gilesii, *F. v. M.* (corolla blue).
" rotundifolia, *F. v. M.*
" Duttonii, *F. v. M.*
Triglochin centrocarpa, *Hooker.*
Stipa crinita. *Gaudichaud.*
Cheilanthes tenuifolia, *Swartz.*

On the Occurrence of Astrorhiza angulosa as a Fossil in the Older Tertiary of Victoria.

In January, 1885, Mr. Henry Watts, of Melbourne, sent me a series of fossil Foraminifera for identification. Among these was a slide containing several examples of the above species,

and is of some interest as being the first instance in which the genus has been obtained in a fossil condition. The genus was founded by Sandahl for a group of arenaceous Foraminifera built up of very fine sand grains, and takes the form of angular, radiating, or branching masses. *A. angulosa* is one of the deep-sea forms described by Mr. H. B. Brady from the Challenger dredgings. It appears to have a very limited distribution in existing seas. The last-named authority states that the figured specimens of his work "are all from station 78, east of Azores, from a depth of 1,000 fathoms, and except for a single example found in one of the Porcupine dredgings in the North Atlantic at 630 fathoms, this is the only locality at which the variety has been collected." The specimens under notice were found, I believe, at Waurn Ponds, near Geelong, and correspond exactly with the subtriangular specimens figured by Mr. Brady.

W. Howchin, *Ed.*

Australian Fossil Bryozoa.

Mr. A. W. Waters, F.G.S., has published two more valuable articles on the fossil Bryozoa of Australia since our last notice of his work in this department. In Quar. Jour. Geol. Soc., Nov., 1884, he deals with the Cyclostomatous group, and figures several new species from Aldinga, the Mount Gambier beds, and from the Tertiaries of the other colonies. Prof. Tate having sent a large series of Bryozoan remains to Mr. Waters, the result of extensive work in the Aldinga and Murray Cliff sections, and including a few from the Adelaide Government bore, Mr. Waters has described them in *loc. cit.*, Aug., 1885. The collection furnishes no less than 73 species, "of which," Mr. Waters states, "46 are known living, bringing the number of Australian fossil Bryozoa described up to 220, of which just about half have been found living." The former article is illustrated by two plates, and the latter by one.

The full list of species as determined by Mr. Waters from South Australian "Older Tertiary" material is as follows:—

1. Cellaria malvinensis, *Busk.*
2. " angustiloba, *B.*
3. Membranipora aperta, *Busk.*
4. " circularis, *d'Orb.*
5. " Savartii, *Aud.*
6. " radicifera, *Hincks.*
7. " rhynchota, *Busk.*
8. " temporaria, *spec. nov.*
9. " Flemingii, *Busk.*

10. Membranipora cylindriformis, *Waters.*
11. " parvicella, *T. Woods.*
12. " Michaudiana, *d'Orb.*
13. " trifolium, *var.*
14. Micropora patula, *Waters.*
15 " perforata, *MacG.*
16. Monoporella crassatina, *Waters.*
17. " sexangularis, *Goldf.*
18. Stenagoporella magnilabris, *Busk.*
19. " Rozieri, *var* indica, *H.*
20. Cribrilina radiata, *Moll.*
21. " figularis, *Johnst.*
22. " terminata, *Waters.*
23. Mucronella mucronata, *Sm.*
24. " nitida, *Verrill.*
25. " coccinea, *var.* mamillata, *B.*
26. " coccinea, *var.* resupinata, *Manz.*
27. Microporella grisea, *Lamx.*
28. " coscinopora, *var.* armata, *W.*
29. " violacea, *Johnst., var.* fissa, *W.*
30. " symmetrica, *Waters.*
31. " ferrea, *Waters.*
32. " pocilliformis, *sp. nov.*
33. " (Lunulites) magna, *Woods.*
34. " magnirostris, *MacG.*
35. " elevata, *Woods.*
36. Porina coronata, *Rss.*
37. Lepralia edax, *Busk.*
38. " depressa, *Busk, var. W.*
39. " rostrigera, *Sm.*
40. " escharella, *Römer.*
41. " burlingtoniensis, *Waters.*
42. " subimmersa, *MacG.*
43. " confinita, *sp. nov.*
44. Smittia Tatei, *T. Woods.*
45. " Landsborovii, *Johnst.*
46. " reticulata, *MacG.*
47. " seriata, *Rss.*
48. " Milneana, *B., var.* cœquata, *W.*
49. Schizoporella vulgaris, *Moll.*
50. " simplex, *J., var.*
51. " phymatopora, *Rss.*
52. " striatula, *Sm.*
53. " fenestrata, *Waters.*
54. " Cecilii, *Aud.*
55. " protensa, *sp. nov.*
56. Mastigophora Dutertrei, *Aud.*

57. Retepora marsupiata, *Sm.*
58. Rhynchopora bispinosa, *Johnst.*
59. Cellepora coronopus, *Busk.*
60. " avicularis, *Hincks.*
61. " costata, *MacG.*
62. " divisa, *sp. nov.*
63. " mamillata, *Busk.*
64. " albirostris, *Sm.*
65. " pertusa, *Sm.*
66. " " *var.* ligulata, *nov.*
67. " biradiata, *sp. nov.*
68. " tridenticulata, *Busk.*
69. " fossa, *Haswell.*
70. " " *var.* marsupiata, *nov.*
71. Lekythopora hystrix, *MacG.*
72. Cupularia Canariensis, *Busk.*
73. Selenaria maculata, *Busk.*

W. Howchin, *Ed.*

Notes on Some Mesozoic Plant-Remains from South Australia. By Henry Woodward, LL.D., F.R.S., F.G.S., &c., (*Geological Magazine*, *July*, 1885.)

Fossils from Mount Babbage consist of plant remains almost entirely converted into a pure quartzite, and include—

(1) A fragment of a small stem considered to belong to the Cycadeæ and named *Mantellia Babbagensis* (Pl. vii., fig. 1-2).

(2) And a badly preserved specimen of *Clathraria* or *Bucklandia* of the Cycadeæ, but which Mr. W. Carruthers, F.R.S., considers a fragment of silicified wood bored into by Teredoes (Pl. vii., fig. 6).

Fossils from Cutaway Hill, Leigh Creek; these consist of impressions of strap-like leaves and slender stalks of some vegetable on a block of quartzite, but do not afford sufficient evidence for exact determination.

Fossil from Mount Adams consists of a quartzite with an impression of a palmate leaf (woodcut), suggestive of the leaf of a *Salisburia*.

The localities of the fossils are mapped as Mesozoic by the Government Geologist, from whom the specimens were received.

R. Tate.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia,

FOR 1884-1885.

ORDINARY MEETING, NOVEMBER 4, 1884.

Professor LAMB in the chair.

BALLOT.—A. A. Lendon, M.D.; John Gosse, M.R.C.S., were elected Fellows; and J. J. East a Corresponding Member.

EXHIBITS.—Mr. Molineux exhibited some insects sent from Kangaroo Island by W. J. Horswill.

Mr. J. J. EAST forwarded a paper on a geological section from the head of St. Vincent Gulf eastward across the basins of the Rivers Wakefield and Light, which was read.

Professor TATE forwarded Remarks on some recent papers upon the "Palæontology of South Australia," which was read.

Mr. F. S. CRAWFORD gave a paper upon the "Shot-hole Disease in Apricot, Almond, and Peach Trees."

ORDINARY MEETING, DECEMBER 2, 1885.

Professor LAMB in the chair.

EXHIBITS.—The skin of *Grallaria pratincola* by Mr. R. H. Pulleine. A caterpillar preserved in glycerine by Mr. Pickels. Mr. Mestayer pointed out that a solution of chloral-hydrate was good for preserving such specimens; and Mr. Tepper remarked that one per cent. of chromic acid added to the glycerine was effectual to prevent softening and shrinkage. Mr. J. W. Jones, Conservator of Water, forwarded portions of the core from the bore at Hergott Springs.

Mr. W. HOWCHIN, F.G.S., read a paper on "Some Fossil Foraminifera found in the Government boring at Hergott, with general remarks on the Section and on other forms of Microzoa observed therein."

Ordinary Meeting, February 5, 1885.

Dr. Whittell in the chair.

Ballot.—Mr. W. A. Jones was elected a Fellow.

Exhibits.—Dr. Cleland showed some fragments of coral found on the surface of a plain fifteen miles north-west of Farina. In reference to this, Mr. Howchin stated that he had been informed by the Conservator of Water that fossils which he (the Conservator of Water) believed to be of Cretaceous age were found close to the surface in that locality, whilst calcareous casts were met with in the boring made in the neighbourhood. A stone showing casts of various molluscs from the bore at Hergott was shown. Dr. Mayo exhibited a lizard (*Œdura rhombifera*), commonly known as the Australian Gecko; also a specimen of *Lactuca saligna*.

Mr. F. H. Edwards, of Marino, wrote, saying that he had trapped some native spotted cats (*Dasyurus*), in the stomachs of which he had found peaches.

A paper by F. W. Andrews was read on the "Nidiology of the *Leipoa ocellata*."

Mr. Tepper showed a new variety of Drosera.

Mr. S. Dixon read a paper on "Some Native South Australian Plants suitable for Cultivation as Fodder."

Mr. Tepper read a paper "On some New and Rare Insects."

Ordinary Meeting, March 3, 1885.

Prof. Lamb in the chair.

Ballot.—Prof. Rennie was elected a Fellow.

Prof. Lamb read a paper on the "Persistency of Electrical Currents in Masses of Iron;" also a paper on the "Cause of Luminosity in Flame."

Prof. Rennie read some remarks on the cause of "Discoloration Observed in certain South Australian Bricks."

Ordinary Meeting, April 14, 1885.

Prof. Lamb in the chair.

Exhibits.—Dr. Stirling exhibited and explained a number of instruments for conducting physiological observations.

Dr. Haacke made observations respecting "Two Remarkable Species of South Australian Fishes;" also concerning "South Australian Rays and Sharks, with special reference to the gravid uterus of the former;" also on the "Colour of Deep-sea Crabs, Boiled Crayfish, and Hermit Crabs;" and "On the gravid uterus of some South Australian Lizards."

Ordinary Meeting, May 5, 1885.

Professor Lamb in the chair.

Ballot.—Mr. Thomas Gill was elected a Fellow.

Exhibits.—Dr. Mayo exhibited a specimen of beetle belonging to the species *Schizorrhina*. Mr. Tepper laid on the table a piece of limestone with regular ovate enclosures. Specimens mounted on glass and immersed in spirit, and prepared by a special method of Mr. Zietz, the *preparateur* at the Museum, were shown. They included one of the *Cyanidæ*, an annelide thickly covered with fine long tentacles, a specimen of *Cydippe pileus*, of *Eudendrium rameum*, of *Limax variegatus*, of *Triton tæniatus* (male and female), and two specimens of *Gecko*. All the exhibits presented a very natural appearance.

Mr. A. W. Jones read a paper upon "Iridiscent Clouds."

Ordinary Meeting, June 2, 1885.

Professor Lamb in the chair.

Ballot.—Mr. W. Ernest Cooke, B.A., was elected a Fellow.

Exhibits.—Mr. Howchin showed a piece of hydratid oxide of iron from Alice Springs, which had been mistaken for a meteorite. Dr. Whittell exhibited and explained the use of a new and simple freezing microtome.

Mr. Howchin made some remarks upon a specimen of *Astrorhiza angulosa* sent over from Victoria by Mr. Watts, and found by him in the Miocene beds of that colony.

Mr. Wragge read a paper on some "Observations made by him during the voyage of the s.s. Maranoa to this colony from England."

Ordinary Meeting, July 7, 1885.

Professor Lamb in the chair.

Ballot.—Mr. R. B. Lucas was elected a Fellow.

Mr. Gavin Scoular forwarded a paper on "Past Climatic Changes in South Australia, with reference to a Glacial Period," which was partly read.

Ordinary Meeting, August 4th, 1885.

Dr. Whittell in the chair.

Ballot.—Dr. Renner was elected a Fellow.

Exhibits.—Mr. Tepper brought an Orchid collected at Cape Willoughby by Mr. J. Horswill, apparently new. He also read a list of fungi collected by him in the neighbourhood of Clarendon.

The remaining portion of Mr. Scoular's paper was read.

A criticism on some portions of Mr. Scoular's argument was forwarded by Prof. Tate and read.

Ordinary Meeting, September 8th, 1885.

Mr. W. Rutt, C.E., in the chair.

Mr. Geo. Styles, of Port Caroline, wrote respecting cyclones, and their tendency to blow towards a centre, and suggested that fuller meteorological observations should be published, so that the advent of storms might be ascertained.

Mr. W. Ernest Cooke, B.A., made some critical remarks in reply, showing that it was by no means an easy thing to forecast the weather, even with the help of the telegraph.

Mr. Bednall forwarded a description of species of *Murex* and *Typhis*, of the coast of South Australia.

Mr. E. Guest sent a paper on the "Nomenclature and Description of some South Australian Butterflies."

The unclassified results of a dredging expedition in St. Vincent Gulf were laid on the table.

Annual Meeting, October 6th, 1885.

Dr. Whittell in the chair.

Mr. L. C. E. Gee was appointed to audit the accounts.

By-laws for the admission of bodies of science-workers, and for their government as Sections of the Royal Society of South Australia, were read, discussed, amended, and adopted.

Exhibits.—Mr. Tepper showed a very large cocoon densely packed with silk, which he had found in a mallee-log. The insect producing it was unknown.

The annual report was then read, as follows:—

ANNUAL REPORT.

The Council has the honour of reporting that the following papers have been laid before it:—"Geological Section from the head of St. Vincent Gulf eastward across the Wakefield and Light River Basins," by J. J. East; "Remarks on Recent Papers upon the Palæontology of South Australia," by Prof. Tate, F.G.S.; "Shothole Disease in Apricot, Almond, and Peach Trees," by F. S. Crawford; "Some Foraminifera Found in the Boring at Hergott Township," by W. Howchin, F.G.S.; "The Nidiology of the *Leipoa ocellata*," by F. W. Andrews; "Some Native South Australian Plants suitable for Cultivation as Fodder," by S. Dixon; "Notes upon New and Rare Insects," by J. G. O. Tepper, F.L.S.; "The Persistency of Electrical Currents in Masses of Iron," by Prof. Lamb, F.R.S.; "The Cause of Luminosity in Flame," by Prof. Lamb, F.R.S.; "Notes on Discolouration Observed in certain Bricks," by Prof. Rennie, D.Sc.; "Two Remarkable Species of South Australian Fishes," by W. L. Haacke, Ph.D.; "Observations respecting South Australian Rays and Sharks, with special

reference to the gravid uterus of the former," by W. L. Haacke, Ph.D.; "On the Colour of Deep-sea Crabs, Boiled Crayfish, and Hermit Crabs," by W. L. Haacke, Ph.D.; "Observations respecting the gravid uterus of some South Australian Lizards," by W. L. Haacke, Ph.D.; "Iridescent Clouds," by W. A. Jones; "Scientific Observations made during the Voyage of the steamer Maranoa from England to South Australia," by C. L. Wragge, F.R.G.S.; "Past Climatic Changes in South Australia, with special reference to a Glacial Period," by Gavin Scoular; "Concerning a Glacial Epoch in South Australia," by Prof. Tate, F.G.S.; "Some Meteorological Observations," by Geo. Styles; "Respecting the Possibility of Forecasting the Weather in South Australia," by W. Ernest Cooke, B.A.; "Description of the Species *Murex* and *Typhis* of the Coast of South Australia," by W. Bednall; "Nomenclature and Description of some South Australian Butterflies," by E. Guest; "The Palliobranchs of the Older Tertiaries," by Prof. Tate, F.G.S.; "The Lamellibranchs of the Older Tertiaries," by Prof. Tate, F.G.S.; "Additions to the Flora of South Australia," by Prof. Tate, F.G.S.

The financial statement was made, and showed that the receipts during the year had been £253 4s. 4d., and the expenditure £201 1s. 11d. The balance at the Bank was £117 2s. 2d., and £250 was placed on deposit. The report and balance-sheet were adopted.

Election of Officers.—President, H. C. Mais, M.I.C.E; Vice-Presidents, W. Howchin, F.G.S., and R. L. Mestayer, C.E.; Hon. Treasurer, Walter Rutt, C.E.; Hon. Secretary, W. L. Cleland, M.B.; Council, Professor Rennie, H. T. Whittell, M.D., E. C. Stirling, M.D., J. W. Bussell, D. B. Adamson, W. E. Cooke, B.A.

The following papers by Professor Tate were laid on the table and taken as read:—"The Palliobranchs of the Older Tertiaries of South Australia," "Additions to the Flora of South Australia." "The Lamellibranchs of the Older Tertiaries of South Australia."

BY-LAWS

Relating to Sections in connection with the Society.

1. With the consent of the Council, Sections may be formed in connection with the Royal Society for the special study of particular branches of natural or applied science.

2. Such Sections shall consist of—

a. Members of the Royal Society who may desire to join the Section, and shall pay the annual subscription.

b. Other persons, not being members of the Royal Society, who shall have been regularly elected subscribers to the Section.

3. Members of the Royal Society who may join any of the Sections shall not be required to pay any entrance fee, and the annual subscription to be paid by them shall not exceed one-half of that to be paid by non-members of the Society.

4. The members of each Section shall elect their own Committee of Management.

5. The President and Vice-Presidents of the Royal Society for the time being shall be *ex-officio* members of the Committee of Management of all Sections that may be formed.

6. The rules and regulations for the management of all Sections shall be submitted to the Council of the Royal Society for their approval, and shall not have any effect until they have been formally approved by the Council.

7. Subscribers to the Sections shall have access to the library of the Royal Society, subject to such regulations as may be made by the Council.

8. The Committee of Management of each Section shall on or before 15th September of each year furnish to the Council of the Royal Society an annual report of the proceedings of the Section, with a balance-sheet, for publication (subject to the approval of the Council) in the Society's annual volume. A copy of such report shall be given to each member of the Section whose subscription for that year shall have been paid.

9. Sections shall be allowed the use of the Society's room at such times as may be approved by the Council.

10. All subscriptions received by any Section must be paid to the Hon. Secretary of the Royal Society, any funds required by such Section being supplied by the Parent Society. Sections should be as far as possible self-supporting, but grants of money may be made to any Section by the Council out of the general funds of the Society.

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Dr.	£	s.	d.	£	s.	d.
October 1st, 1884.						
To Balance brought forward				314	19	9
Subscriptions—Royal Society	98	8	6			
Field Naturalists' Sec.	18	5	0			
				116	13	6
Government Grant (first instalment)				99	0	10
Interest				12	10	0
Sale of Bookcase				25	0	0
				£568	4	1

Cr.	£	s.	d.	£	s.	d.
By Cost of Transactions—						
Printing and Binding	49	5	9			
Illustrating	36	1	0			
Publishing	4	5	11			
				89	12	8
Subscription to S.A. Institute (nine months)				9	0	0
Salaries, &c.—Assistant Secretary ..	21	0	0			
Attendant	1	7	0			
				22	7	0
Advertising				4	18	11
Printing, Postage, and Stationery ..				23	15	1
Field Naturalists' Section—Grants ..	55	0	0			
Stationery (Postal Microscopical Exchange)	3	14	0			
	58	14	0			
Less Repaid by Section	7	5	9			
				51	8	3
Balance—Bank of South Australia ..	139	16	3			
Savings Bank	250	0	0			
	389	16	3			
Less Outstanding Cheque ..	22	14	1			
				367	2	2
				£568	4	1

Audited and found correct,

LIONEL C. E. GEE, Auditor.

6th October, 1885.

WALTER RUTT, Treasurer.

DONATIONS TO THE LIBRARY

For the Year 1884-5.

I.—Transactions, Journals, and Reports.

Presented by the respective Societies, Editors, and Governments.

Ballarat School of Mines—Annual Report for 1884.

Baltimore—American Chemical Journal. By Ira Remson. Vol. VI., No. 4.

——— Johns Hopkins' University Circular. Vol. IV., No. 41.

——— Johns Hopkins' Third Series "Historical and Political Science;" VIII. "The Influence of the Proprietors in Founding the State of New Jersey."

Batavia—Catalogues des Bibliotheck van de Koninkligke-Natuurkundige Vereeniging in Nederlandsch-Indie.

Belfast—Report and Proceedings of the Belfast Natural History and Philosophical Society for 1883-84.

Berlin—Sitzungberichte der königlich-Preussischen Akademie der Wissenschaften zu Berlin; 1884. Nos. 18 to 39. XXX.-XXXI. and XXXIV.-XXXV.

Boston—Proceedings of the American Academy of Arts and Sciences. Vol. XI., parts 1 and 2.

Bruxelles—La Chronologie Geologique; Discours prononcé à la Séance Publique de la Classe des Sciences de l'Academie Royale de Belgique.

Buenos Aires—Boletin de la Academia Naçional Ciencias en Cordoba (Republica Argentina, Tomo 6, Entregas 2a y 3a.

Cambridge, U.S.A.—Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College for 1883-84.

——————— Bulletin of the Museum of Comparative Zoology at Harvard College, vol. XII., No. 1.; vol. XI., No. 11.

——————— Studies from the Newport Marine Laboratory.

Cape Town—Transactions of the South African Philosophical Society, vol. iii., 1881-83.

Christiana—Den Norske Nordhavs Expedition 1876-78. XI. Zoologi-Asteroidæ. XII. Zoologi-Pennalulida. XIII. Zoologi-Spongiadæ. Geodätische Arbeiten, Heft IV. Vandstandsobservationer, Heft III. XIV. Zoologi, Crustaca, 1a and 1b.

Colorado—The Artesian Springs of Denver. Report by a Special Committee of the Colorado Scientific Society.

Dublin—The Scientific Transactions of the Royal Dublin Society, vol. 1, series 2, Nos. 20, 21 (two copies), 23, and 25. Vol. 3, series 2, Nos. 1, 2, 3.

——— Proceedings of the Royal Dublin Society, vol. 3, new series; parts 6, 7. Vol. 4, parts 1, 2, 3.

Edinburgh—Proceedings of the Royal Society of Edinburgh, Session 1881-82, 1882-83.

——— Proceedings of the Royal Physical Society, Session 1883-84; vol. VIII., part 1.

Göttingen—Nachrichter von der K. Gesellschaft der Wissenschaften und der Georg.-Augusts. Universität zu Gottingen, Aus dem Jahre, 1883; No. 1-13.

Halle, 1881-82-83—Leopoldina. Amptliches organ der Kaiserlichen - Leopoldino - Carolinischen-Deutschen Akademie der Naturforscher, 1881-82-83.

London—Proceedings of the Royal Colonial Institute; vol. XV.

——— Proceedings of the Royal Society; vol. XXXVII., Nos. 227 to 231.

——— Journal of the Royal Microscopical Society; Series II., vol. IV., Part 5, 6; vol. V., Part 1, 2, 3, 4.

——— Transactions of the Entomological Society of London for 1884.

——— Proceedings of Royal Colonial Institute, 1884-5.

Manchester, 1883—Memoirs of the Manchester Literary and Philosophical Society; vols. VII., IX., XX., and XXII.

Montreal—Geological and Natural History Survey and Museum of Canada. Report of Progress, 1882-83-84 (with forty maps in six sets), separate.

——— Do., do. Catalogue of Canadian Plants; Part 2, Gamopetalæ.

Munich—Sitzungberichte der mathematische-physicalischen Classe der Königlich-Bayerischen Akademie der Wissenschaften zu München. 1883-4.

——— Abhandlungen der mathematisch - physicalischen

Classe der Königlich-Bayerischen Akademie der Wissenschaften zu München. Denschriften 52, part 1.

Munich—Gedächtnissrede auf Theodor L. W. von Bischoff, gehalten in der offentlichen Sitzungder Königlich-Bayerischen Akademie der Wissenschaften zu München, zu Feier ihres einhundert und fünfundzwanzigster Stiftunstages am 28 Marz, 1884. Von Carl Kupffer, O. Mittgleide, mathematisch-physicalischen Classe der K.-B. Akademie.

——— Franz von Kobell. Eine Denkschrift, Von K. Haushöfer, a.o. Mitgleid der Königlich-Bayerischen Akademie der Wissenschaften zu München.

New Zealand, 1884—Reports of Geological Explorations during 1883-4.

——————— Meteorological Report, 1883.

——————— Report of the Auckland Institute and Museum for 1884-85.

——————— Transactions and Proceedings for the New Zealand Institute, 1884. Vol. XVII.

——————— Nineteenth Annual Report of the Colonial Museum and Laboratory for 1883-4.

New South Wales—Journal and Proceedings of the Royal Society of New South Wales for 1883. Vol. XVII.; vols. X., XI, and XVIII.

——————— Proceedings of the Linnean Society of New South Wales. Vol. IX., parts 3, 4; vol. X., parts 1, 2.

Paris—Bulletin de la Société Académique Indo-Chinoise-Année, 1881.

—— Archive de la Société Amerique de France. Nouvelle Series; tome II., part 1.

—— Epreuves pour Corrections et Additions de la Liste Générale des Membres da Congres International des Orientales. 1c. Session; Paris, 1873.

—— Société Ethnographique. Statuts révisés pas le Coureit et adoptés par l'Assemblie Generale, le 3 Mars, 1879.

—— Institution Ethnographique: Instructions pour les Délégations. 2c ed.; Revue et Augmenta.

—— Annuaire de l'Athénée Oriental. Public par Victor Dumas, 1866.

—— Annuaire de la Société d'Ethnographie, 1881.

—— Rapport Annuel sur les Recompenses et Encouragements decernes en 1883.

Philadelphia—Proceedings of the Academy of Natural Sciences of Philadelphia. Part II., May, October, 1884. Part III., Nov., Dec., 1885; part 1.

Salem—Annual Report of the Trustees of the Peabody Academy of Sciences, 1874 to 1884.

San Francisco, California—Bulletin of the California Academy of Sciences, Nos. 1, 2, 3.

St. Louis—Transactions of the Academy of Science, vol. IV., No. 3.

South Australia—Final Report of the South Australian Institute for the nine months ended June 30, 1884.

——— Proceedings of Parliament and Papers, 1884, vols. I., II., III., IV.

——— Reports on Planting Olives and Mulberries on Mallee Lands in the Far North, and Wattle Cultivation generally in the Colony, by J. E. Brown, F.L.S., &c.

——— Meteorological Observations made at the Adelaide Observatory in 1882, by Chas. Todd, C.M.G., F.R.A.S., &c.

——— Report on the Post Office, Telegraph, and Observatory Departments, by Chas. Todd, C.M.G., F.R.A.S., &c.

——— Notes on the Echunga Goldfields, with maps, by H. Y. L. Brown, Government Geologist.

——— Reports on Geology of Country East of Farina, and Northward to lat. 23° 10′, with map, by H. Y. L. Brown.

——— Report of the Geological Character of Country passed over from Port Augusta to Eucla.

——— Report of Board of Governors Public Library, Museum, and Art Gallery, 1884-5.

Tasmania—Abstracts of Proceedings of the Royal Society of Tasmania on 13th October, 1884.

——— Papers ordered by the Legislature to be printed.

Victoria—Victorian Year Book for 1883-4, by H. H. Hayter, C.M.G.

——— Statistical Register of the Colony of Victoria for 1883—Part IV., Interchange; Part V., Vital, &c.; Part VI., Production, &c.; Parts VII., VIII., IX., Index—1884; P1, Bluebook.

——— Government Statistics, Annual Report on Vital Statistics of Melbourne and Suburbs, 1884.

Victoria—Australasian Statistics, 1883.
——— Sixth Annual Report of the Proceedings of the Government Statist in connection with Friendly Societies.
——— Part II. (1884), Population; III., Finance, &c.
——— Southern Science Record, New Series, January, 1885, 1, 2.
——— The Victorian Naturalist, vol. I., No. 11; vol. II., Nos. 2 and 3; Nos. 4, 5, 7.
——— Australasian Scientific Magazine, No. 1, vol. I.
——— The Australasian Journal of Pharmacy, vol. I., No. 1.
——— Transactions and Proceedings of the Royal Society of Victoria, vol. XXI.
——— Russell's Map of Early Melbourne, from Public Library of Melbourne.
——— Agricultural Statistics to March, 1885.
——— The Victorian Naturalist, vol. I., No 11; vol. II., No. 2.
——— Results of Astronomical Observations at the Melbourne Observatory for 1876 to 1880 inclusive.
Vienna—Kaiserlich Akademie der Wissenschaften in Wien, Sitzung der Mathematisch-naturwissenschaftlichen Classe. Nos. 20 to 27, 1884; 28, 1885; and 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16.
——— Beiblatt zu den Mittheilungen des Ornithologischen Vereines in Wien, 1884; Nos. 6 to 25.
——— Mittheilungen des Orinithologischen Vereines in Wien, 1885; Nos. 8 to 12; Nos. 1 to 7.
——— Verhandlungen der K. K. Geologischen Reichsanstalt, 1884.
——— Mittheilungen des Ornithologischen Vereines in Wien, 2 Jahr; Nos. 1 to 25; Section für Geflurgetzucht und Brieftaubenweisen.
Washington—Report of the U.S. Geological Survey of the Territories; vol. VI.
Do. do. Mineral Resources of the United States.
———— Annual Report of the Board of Regents of the Smithsonian Institute for 1882.
Wurzburg—Sitzungberichts der Physicalisch-Medicinischen Gesellschaft zu Würzburg, Jahrgang, 1884.

II.—Books and Pamphlets.

(Names of donors in italics.)

Australian Museum Governors—List of Old Documents and Relics in the Australian Museum.

Bale, W. M.—Catalogue of Australian Hydroid Zoophytes.

Brazier, John—The Synonomy of and Remarks on the Specific Names and Authorities of Four Species of Australian Marine Shells.

———— On some recent Shells found in layers of clay on the Macleay Coast, New Guinea.

———— Critical List of Mollusca from North-West Coast of Australia.

Browne, H. J.—The Higher Sciences; or, Materialism Refuted by facts.

Hutton, F. W.—The Origin of the Fauna and Flora of New Zealand.

Institution d'Ethnographie—L'âme Humaine au Point de vue de la Science Ethnographique.

Lamb, H.—History of Electrical Magnetism.

———— On the Induction of Electric Currents in Cylindrical and Spherical Conductors.

———— On the Mutual Potential of Two Lines in Space.

Liveridge, A.—On the Chemical Composition of certain Rocks, N.S.W.

———— On some New South Wales Minerals.

Mueller, Baron F.—Eucalyptographia; Tenth Decade.

———— Second Annual Supplement to the Systematic Census of Australian Plants.

Putman, C. E.—Elephant Pipes at the Museum, Davenport, Iowa.

Rosney, Léon—Vocabulaire de l'écriture Niératique Yucatèque.

Russell—Map of early Melbourne.

Selwyn and Dawson—Descriptive Sketch of the Physical Geography and Geology of the Dominion of Canada.

Stirling, James—Notes on the Meteorology of the Australian Alps.

Tolmie, W. F.—Comparative Vocabularies of the Indian Tribes of British Columbia, with maps.

Topley, William—The National Geological Surveys of Europe.

Tyron, W.—Manual of Conchology.

Woodward, H. P.—Reprint of Papers from the "Geological Magazine."

LIST OF FELLOWS, MEMBERS, &c.

NOVEMBER, 1885.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

		Date of Election
HONORARY FELLOWS.		
Angas, Geo. French, F.L.S., C.M.Z.S.	London	1879
Barkley, Sir Henry, K.C.M.G., K.C.B.		1857
Ellery, R. L. J., F.R.S.	Melbourne	1876
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart	1855
Jervois, Sir W. F. D., K.C.M.G., C.B.	New Zealand	1878
Little, E.		1855
Macleay, Hon. W., F.L.S.,	Sydney	1878
*Mueller, Baron F. von, K.C.M.G., F.R.S.	Melbourne	1879
Russell, H. C., B.A., F.R.A.S.,	Sydney	1876
Warburton, Col. P. E., C.M.G.	Beaumont	1858
*Woods, Rev. J. E. T., F.L.S., F.G.S.	Sydney	1877
CORRESPONDING MEMBERS.		
Bailey, F. M., F.L.S.	Brisbane	1881
Canham, J.	Stuart's Creek	1880
Chandler, T.	Peake	1881
*Cloud, T. C., F.C.S.	Wallaroo	1881
*East, J. J.	Mallala	1884
*Foelsche, Paul	Palmerston	1882
Goldstein, J. R. Y.	Melbourne	1880
*Hayter, H. H., M.A., C.M.G., F.S.S.	Melbourne	1878
Holtze, Maurice	Palmerston	1882
*Kempe, Rev. J.	Finke	1880
*Richards, Mrs. A.	Port Augusta	1880
*Scoular, Gavin	Smithfield	1878
*Stirling, James, F.L.S.	Omeo	1883
FELLOWS.		
*Adamson, D. B.	Adelaide	1867
Abbott, A. G.	Kingston	1884
Angas, J. H.	Angaston	1874
Beresford, D. J. D.	Adelaide	1884
Black, A. B.	Adelaide	1882
Boettger, Otto	Adelaide	1884
Brown, J. E., F.L.S.	Adelaide	1882
Brown, L. G.	Two Wells	1882
Browne, H. Y. L., F.G.S.	Adelaide	1883
Bruer, J.	Adelaide	1883
Brunskill, Geo.	Morgan	1878
Burchell, F. N.	Adelaide	1881
Bussell, J. W.	Adelaide	1884

*Campbell, Hon. Allan, M.L.C., L.R.C.P. Edin.	Adelaide	1882
Caterer, T. A., B.A.	Norwood	1882
*Chalwin, Thos., M.R.C.V.S. Eng.	Adelaide	1877
Chapple, F., B A., B.Sc.	Prince Alfred College	1876
*Cleland, W. L., M.B., Ch.M., F.R.M.S.	Parkside	1879
*(L) Cooke, E.	Adelaide	1876
*Cooke, W. Ernest, B.A.	Adelaide	1885
Cox, W. C.	Semaphore	1880
Cornish, W. H.	Adelaide	1883
*Crawford, F. S.	Adelaide	1865
*Davenport, Sir Samuel	Adelaide	1856
Davies, Edward	Adelaide	1882
Davis, F. W.	Adelaide	1882
Dobbie, A. W.	Adelaide	1876
Elder, Sir Thomas	Adelaide	1871
Evans, Thomas	Adelaide	1883
Farrar, G. E.	Adelaide	1882
*Fletcher, Rev. W. R., M.A.	Kent Town	1876
Foote, H.	Outalpa	1883
Fowler, W.	Kulpara	1882
Gall, David	North Adelaide	1865
Gardner, Wm., M.D., C.M.	Adelaide	1882
Gee, Lionel, C. E.	Adelaide	1882
Giles, G. F.	Adelaide	1883
Gill, George	Adelaide	1884
Gill, H. P.	Adelaide	1883
Gill, Thomas	Adelaide	1885
Gosse, John, M.R.C.S.	Wallaroo	1884
*Goyder, Geo., jun	Adelaide	1880
Grundy, E. B.	Adelaide	1882
*Haacke, Wm., Ph.D.	Adelaide	1882
*Harris, C. H.	Adelaide	1883
Harrold, A. L.	Adelaide	1876
*Haslam, John	Adelaide	1883
Hay, Hon. A., M.L.C.	Adelaide	1861
Henry, A., M.D.	Adelaide	1882
*Hill, W.	Mitcham	1884
Hopkins, Rev. W.	Adelaide	1880
*Howchin, W., F.G.S.	Goodwood East	1883
Hughes, H. W.	Booyoolie	1883
*Hullett, J. W. H.	Port Augusta	1876
Johnson, J. A.	Adelaide	1875
*Jones, W. E.	Parkside	1885
*(F) Kay, R.	Adelaide	1853
Kelly, Rev. Robert	Mount Barker	1884
Knevett, S.	Adelaide	1878
*Lamb, Prof., M.A., F.R.S.	England	1883
*Laughton, E.	Adelaide	1874
Lendon, A. A., M.D.	Adelaide	1884
*Lloyd, J. S.	Adelaide	1856
Magarey, A. T.	North Adelaide	1873
*Magarey, S. J., M.B.	Adelaide	1874
Mais, H. C., M.I.C.E.	Adelaide	1883
*Mayo, Geo., F.R.C.S.	Adelaide	1853
Mayo, G. G.	Adelaide	1874
Mestayer, R. L., F.R.M.S.	Adelaide	1883
*Meyrick, E., B.A.	Sydney	1881

Middleton, W. J. E.	Kangarilla		1882
Mohan, J. H.	Crafers		1883
Molineux, A.	Kent Town		1880
(L) Murray, Hon. David, M.L.C.	Adelaide		1859
Munton, H. S.	Adelaide		1884
Nesbitt, W. Peel, M.B.	England		1880
Neale, W. L.	Adelaide		1884
O'Leary, M. P., M.R.C.S.	Port Victor		1884
Parker, Thomas, C. E.	Port Adelaide		1883
Phillips, W. H.	Adelaide		1883
Pickels, W. E., F.R.M.S.	Adelaide		1883
Poulton, B., M.D.	Adelaide		1883
Rigaud, R. J.	Adelaide		1882
Robertson, R., F.F.P.S.	Adelaide		1882
*Rennie, Prof., D.Sc., F.C.S.	Adelaide		1885
Renner, F. E., M.D.	Carrieton		1885
Russell, William	Port Adelaide		1879
*Rutt, Walter, C.E.,	Adelaide		1866
Salom, Hon. M., M.L.C.	Adelaide		1866
*Schomburgk, R., Ph.D.	Adelaide		1865
*Smeaton, Stirling, B.A.	Adelaide		1882
*Smeaton, Thos. D.	Mount Barker		1857
Smith, E. Mitchell	Adelaide		1883
Smith, R. Barr	Adelaide		1871
Smyth, C. B.	Adelaide		1884
Smyth, J. Y., B.A., B.E.	Norwood		1882
Sparks, H. Y.	Glenelg		1878
Spiller, E.	Adelaide		1884
*Stirling, E. C., M.D., F.R.C.S., M.P.	Adelaide		1881
Stuckey, J. J., M.A.	Adelaide		1878
*Tate, Prof. R., F.G.S.	Adelaide		1876
*Thomas, J. D., M.D.	Adelaide		1877
Thow, William	Woodville		1878
*Tietkins, W. H., F.R.G.S.	Millswood		1881
*Tepper, J. G. O., F.L.S.	Norwood		1878
*Todd, Charles, C.M.G., F.R.A.S.	Adelaide		1856
Tyas, J. W.	Adelaide		1882
Umbehaum, C.	Adelaide		1879
*Varley, A. K.	Mount Gambier		1883
*Verco, J. C., M.D.	Adelaide		1878
Vickery, G.	Meadows		1868
Ware, W. L.	Adelaide		1878
Wainwright, E. H., B.Sc.	St. Peter's College		1883
Watson, Rev. John	Parkside		1884
Way, E. W., M.B.	Adelaide		1879
Way, S. J., Chief Justice	Adelaide		1859
Wheeler, F.	Adelaide		1884
White, R. A.	Adelaide		1882
Whiting, J. B.	Adelaide		1882
*Whittell, H., M.D., F.R.M.S.	Adelaide		1882
Woodward, H. P., F.G.S.	Adelaide		1883
*Wragge, C. L., F.R.G.S.	Adelaide		1877
Wyatt, Wm., M.R.C.S.	Burnside		1859
Young, Wm., M.A.	Hindmarsh		1880

ASSOCIATES.

Burchell, D.	Adelaide		1883
Hodgson, Mrs.	Port Victor		1884

APPENDIX.

PROCEEDINGS

OF THE

Field Naturalists' Section of the Royal Society

1884-85.

RULES OF THE FIELD NATURALISTS' SECTION.

1. The general management of this Section shall be controlled by a Chairman, two Vice-Chairmen, a Secretary, and a Committee of eight, five to form a quorum.

2. The Chairman, Vice-Chairmen, and Committee shall be elected at the annual meeting in October.

3. The Chairman shall not be eligible for office for more than two consecutive years, and one of the Vice-Chairmen shall retire each year.

4. Candidates for admission, not being members of the Royal Society, must be proposed and seconded by two members of the Section at one meeting, and be balloted for at the next ensuing meeting; one black ball in five to exclude.

5. Evening meetings shall be held on Tuesdays, at the discretion of the Committee of Management, for the purpose of reading papers, dealing with the natural history of Australia (more particularly of the neighbourhood of Adelaide), or for the purpose of mutual instruction.

6. There shall be at least eight Field Meetings during the year; the time and place to be arranged by the Committee.

7. At the annual general meeting a statement of accounts shall be submitted by the Secretary and duly certified by two auditors appointed at the previous ordinary meeting, preparatory to being handed to the Treasurer of the Royal Society.

8. The Section may from time to time elect as honorary members those who have been proposed and seconded in the usual way, and have been unanimously elected by ballot. This shall also apply to corresponding members.

9. Any member owing the subscription to the Section and neglecting to pay the same on or before the first day of January, shall be liable to have his name removed from the list of members of the Section; provided always that written application for the same shall first have been made by or on behalf of the Treasurer of the Royal Society; and, provided also, that the Committee shall have power to restore the defaulter's name at his request, after payment of arrears.

10. The rules and regulations of the Section shall not be altered unless a

written notice of motion, signed by not less than five members, be given at a meeting of the Section; and thereupon such motion may be brought forward at the next meeting.

11. Any resolution passed under rule 10, altering or repealing the rules of the Section, shall be in force until the meeting held in the month of October following; and if not then confirmed, shall thereafter be held void and of no effect.

12. On the written requisition of twenty members, delivered to the Secretary, an extraordinary general meeting may be called to consider and decide upon the subject mentioned in the requisition.

13. The Committee shall be empowered to frame rules for the conduct of excursions arranged for by them.

14. Fellows of the Royal Society who are members of the Field Naturalists' Section shall pay to this Section an annual registration fee of one shilling each.

REGULATIONS OF THE ROYAL SOCIETY FOR THE FIELD NATURALISTS' SECTION.

1. This Section is established to promote the practical study of Natural History by affording fuller opportunities and facilities for meeting and working together.

2. The Section shall consist of—

(*a*) Fellows and Associates of the Royal Society who shall have signed the rules of the Section.

(*b*) Ladies and gentlemen, not members of the Royal Society, who shall become subscribers to the Section.

3. The members of the Section shall elect their own Committee of Management.

4. Subscribers to the Section shall pay annually, in advance, five shillings; the year to terminate on the 31st day of October.

5. Subscribers to the Section shall have access to the Library of the Society, and shall be entitled to a copy of the "Miscellaneous Contributions to Natural History" and the "Annual Reports" published by the Society for the current year.

6. The Committee of Management shall furnish to the Honorary Secretary of the Royal Society an annual report of the proceedings of the Section in time for publication in the Royal Society's annual volume.

7. By application to the Council of the Royal Society grants of money may be made to the Section out of the general funds of the Society.

RULES FOR THE CONDUCT OF FIELD EXCURSIONS.

1. Each member shall have the privilege of introducing two friends, such privilege not to extend to any person who shall have been a visitor at two successive meetings.

2. A Chairman to be elected as at ordinary meetings.

3. The Secretary to act as conductor, or in his absence, some member of the Committee nominated by him.

4. No change to be made in the programme, or extra expense incurred, except by the consent of two-thirds of the members present.

5. No fees, gratuities, or other expense to be paid except through the conductor.

6. Every member or visitor to have the accommodation assigned by the

conductor. Where accommodation is limited, consideration will be given to priority of application.

7. Accommodation cannot be supplied unless tickets are obtained before the time mentioned in the special circular.

8. Those who attend an excursion without previous notice will be liable to extra charge, if extra cost be thereby incurred.

9. No intoxicating liquors shall be provided at the expense of the Section.

———o———

EXCURSIONS.

First Excursion—Monday, November 10, 1884.—Golden Grove, &c.

About fifty ladies and gentlemen proceeded on this date by coach to Golden Grove, Bishop's Springs, and the gorge of the Little Para River. On arrival at Bishop's Springs a meeting was held, at which five new members were elected, and votes of thanks passed to the Right Rev. C. A. Reynolds and Mr. John Robertson, J.P., for their courtesy in permitting members of the Section to make use of their grounds. Prof. Tate then addressed the party, and said he was glad to avail himself of the opportunity of explaining to the members a few of the salient rock features of the locality. They consisted of thickly-bedded sandstones and grits forty to sixty feet thick, and intercalated among clay slates. There were four of these bands, and where they were intersected by the stream-courses they formed waterfalls. They were traceable on the surface as colossal walls, and on the elevated grounds appeared at a distance like Cyclopean ruins. From their moderate dip and the varying slopes of the ground, and the presence of two deep waterways, the outline on the surface of the grit bands somewhat resembled a collection of the letters V and W, all inverted, and altogether afforded very interesting examples of the chief phenomena of stratification. These bands, which had previously been supposed to be of igneous origin, had been proved by Mr. Scoular, who had studied them at this and neighbouring places, to be of sedimentary origin, some evidences of which (such as the lamination of the lower part of the grits) were observable in the sections examined by the party. The position of these bands, in addition to forming a waterfall, had caused a deflection of the stream which flowed along the base for several hundred yards, by which a long mural line of cliff is maintained. This was the habitat of a rare plant in the southern portions of the colony, the *Scleranthus pungens*. The Professor indicated that a botanical feature was noticeable in connection with the grits, viz., the prevalence of the sheaoak (*Casuarina quadrivalvis*), and explained that even where the grits did not form any marked outcrop, their presence was in-

variably determined by the existence of this forest tree, especially in the broad belt of timber that crowned the main road approaching Golden Grove. The graceful poison-berry tree, *Pittosporum phillryæoides*, is here exclusively confined to the same habitat in this locality. *Bulinus texturatus* was collected in the river. The habitat of the *Quinetia Urvillei*, a very rare annual of West Australian origin, discovered here some years ago by Professor Tate, was visited. Here *Ptilotus erubescens* was found; and then the scrub at Golden Grove was explored, but the many floral productions for which it is famous had now almost passed away. A few, however, remained, among which were *Daviesia ulicina*, var. *ruscifolia*, and the grass *Amphipogon strictus*. The Professor explained that the surface drainage from the scrub had in the course of a few years cut for itself a channel some yards in width, and of a depth of twenty feet in the sands and clays which overlie the sandstones and stiff argillaceous beds of the "Upland Miocene." The same beds were also visible in the roadside cuttings, where the horizontal arrangement of these sandstones are unconformable to the grits of the old rocks. The peculiar vegetation of these scrublands was at this place clearly seen to be referable to this geological phenomenon.

Second Excursion—Thursday, January 1, 1885.—Uraidla.

About thirty members and friends of the Section proceeded to Uraidla via Norton's Summit. On arrival at Uraidla the party were met by Mr. Grasby, of Oakbank, and Mr. Wilson, of Uraidla, who courteously volunteered their services as guides.

After walking for about a mile a meeting was held—Mr. W. H. Selway, jun., presiding—and two new members elected, and a hearty vote of thanks passed to Mr. Wilson. The party then descended to the foot of a waterfall at the head of a beautiful glen.

After lunch the walk was commenced, and on the way attention was directed to the undulated foliation of the slates and quartzitic grits wherever exposed in the rocky walls bordering the deep gullies along which the road lay, and which was produced by lateral pressure. The talcose slates generally occupy the lower portions of the hillsides, while the quartzites dominate the ridges, which are usually occupied by the stringybark forests. It was pointed out that the configuration of the country, inclusive of almost equi-distant secondary lateral gullies, was due to erosion by the agency of rain upon strata of different densities. The formation was the same as that formerly observed at Crafers and the neighbourhood of

Mount Lofty, which was composed of rocks of pre-Silurian age, concealed mostly by soil formed by their disintegration, and, so far as known, devoid of fossils. There was much that was interesting in the botanical features of the trip, and Mr. Tepper indicated that as the elevation above the level of the plain increased the vegetation changed considerably in character. Near the foot of the rise the peppermint gum, *Eucalyptus odoratus*, was met with, reaching to a height of more than 1,000 feet above sea level, where *E. leucoxylon* (blue gum) took its place; this at a height of 1,300 or 1,400 feet being succeeded by the two stringybarks *E. obliqua* and *E. capitellata*. In the stringybark level were found in flower *Leptospermum myrsinoides* and *Gompholobium minus*. The latter is generally yellow, but a brilliant red specimen was also found. *Candollea graminifolia*, with its sensitive style, the climber *Marianthus bignoniaceus*, *Aster Sonderi* (flowers pure white, and about two inches across), *A. Huegelli* (both purple and white), *Comesperma calymega*, were also gathered. In the highest elevations were *Brunonia australis*, *Pultenea villifera*, and a few late specimens of the orchid *Dipodium punctatum*. The two sedges *Lepidospermum carphoides* and *L. filiforme* were found on the road leading to Norton's Summit. *Eryngium rostratum*, with blue flowers almost hidden in a curious spray-head of foliage, the large white flowers of *Pimelea octophylla* and *P. glauca*, were also found. At the foot of the waterfall were fine specimens of *Veronica Derwentia*, about six feet high, with conical spikes of white flowers, and *Epilobium tetragonum*, var. *pallidum*, with long pale pink flowers. The ferns *Lomaria discolor*, *L. capensis*, *Adiantum æthiopicum*, and *Osmunda* (*Todea*) *barbara* were setting their spores. Amongst a large number of plants in fruit were *Daviesia corymbosa*, *D. ulicina*, and *D. brevifolia*; *Stackhousia* sp., *Dillwynia hispida*, *Xerotes sororia*, and two other species.

Third Excursion—Saturday, Jan. 24, 1885.—Ambleside.

About forty ladies and gentlemen left by the 1.10 train for Ambleside, and on arrival there a start was made for the banks of the River Onkaparinga. After a meeting, under the presidency of Professor Tate, at which four new members were elected, Mr. E. Guest led the way northwards. In spite of the lateness of the season, the district was rich in botanical specimens.

Among the plants found were *Opercularia ovata*, *Mentha gracilis* and *M. australis*, *Hypericum japonicum*, *Alternanthera triandra*, *Brachycome graminea*, *Epilobium tetragonum*, *Polygonum minus*, *Myriophyllum variifolium* and *M. elatinoides*,

Potamogeton obtusifolius, *Helichrysum rutidolepis*, and *Potentilla anserina*. This last is said to be found only in this immediate locality. Mr. Tepper was fortunate to discover *Haloragis heterophylla*, distinguished by its digitate leaves. The tall shrubs by the riverside — *Bursaria spinosa*, *Leptospermum lanigerum*, and *Acacia retinodes*—were in full flower. *Lythrum salicaria*, with its purple flowers, was also gathered.

Of the sedges collected, the most noteworthy were *Cyperus lucidus*, *C. textilis*, *Juncus planifolius*, *J. prismatocarpus*, *J. cæspititius*, and *Scirpus inundatus*. Of grasses, the tall *Poa caespitosa* was found in fruit, together with *Echinopogon ovatus* and *Eragrostis Brownii*, and *Ehrharta stipoides*. On the railway line *Hæmarthria compressa* was seen in flower, and varieties of the aquatic plant, *Triglochin procera*, were in full fruit.

The party followed the Onkaparinga as far as the railway bridge, and then returned to the station, which was left at 4.45, the city being reached shortly after 6 o'clock.

Fourth Excursion—Saturday, Feb. 14, 1885.—Largs Bay.

The members assembled at the North-terrace Railway Station at a later hour than usual, and proceeded to Largs Bay. On arrival there Mr. J. G. O. Tepper presided over a business meeting, at which two new members were elected. He then introduced Mr. W. T. Bednall, who had consented to act as leader.

Mr. Bednall explained that the weather had scarcely been conducive to the chance of finding many good marine specimens, but by careful search the members might add something valuable to their collections. He pointed out that the *Venus scalarina* (the common cockle) was the predominant shell in this locality, its distribution being very local and confined from Largs Bay to about a mile south of the Semaphore. From there southwards this shell was replaced by another sand-living bivalve, the *Mactra polita*, only a very few specimens of which were taken. Mr. Bednall then suggested a number of other species of shells that might be found; but, as he intimated at first, the result of the searching was not particularly interesting.

After being advised to collect the sand and small shells which would be found in little heaps, and to dry it for examination under the microscope, when there would probably be discovered beautiful specimens of small shells, diatoms, foraminifera, and corallines, the party took a northerly direction along the beach.

During the journey Mr. Tepper explained that there was a distinction between the submarine flowering plants and seaweed. The plants *Cymodocea antarctica* and *Posidonia australis*, found in such large quantities on the beach, were commonly mistaken for algæ (seaweed). The difference shown in the appearance of the seaweed and the seaplant was very marked; but the distinction in classification seemed to be rather finely drawn. A good specimen of *Halophila ovalis* (marine plant) and some others were shown, but nothing worth mentioning was found in algæ, probably because the attention of the members seemed to be confined to the shells. Very few specimens were taken alive, but a fairly good collection was made of *Triton Quoyi*, *Nassa fasciata*, *Columbella Lincolnensis*, *Natica conica*, *Sigaretus zonalis*, *Conus rutilus*, *Bittium turritella*, *Mactra pura*, *Hiatula biradiata*, *Arca lima*. Only broken specimens of *Pecten australis*, *P. bifrons*, and *P. laticostatus* could be obtained by such a casual examination. *Solemya australis* was uncommonly abundant, but small and in parts only. *Phasianella bulimoides* (pheasant shell) was rather scarce. Mr. Molineux obtained one of the latter alive, which he explained had, by the appearance of the shell, evidently at some time been attacked by a stingray, but eluded the enemy. The shell had been broken, and had grown again with an additional patch on the outside, which was not an infrequent occurrence. Much interest was imparted to the excursion by little dissertations upon the habits of land and marine life, in many cases a very complete comparison being made.

Fifth Excursion—Saturday, March 7, 1885.—Bridgewater.

The party arrived at Bridgewater about 2.30, where they were met by Professor Tate, and started to walk down Cox's Creek, along which they proceeded for about a mile. On the way were seen the creeper *Marianthus bignoniaceus*, and the native fuchsia, *Correa decumbens*, with yellow as well as red flowers. Along the banks of the creek was discovered the handsome sedge, *Cladium Mariscus*. The blue-bell, *Wahlenbergia gracilis*, was found in abundance, and it was stated that this plant had been exhibited at the Royal Agricultural Show as a fodder-plant, whereas if not poisonous it was at least very unwholesome. *Lobelia microsperma*, which plant is stated to have caused the death of much valuable stock, was noticed, as was also the white everlasting, *Ixodia achilleoides*, a flower peculiar to the Mount Lofty Ranges and the South-east Desert. The bright *Goodenia ovata* was very plentiful.

The party eventually arrived at a waterfall, the basin of which is enclosed on three sides with high rocks. Professor

Tate explained that the higher ground here was composed of grits and friable sandstones, while the hard grits made up the valley bottoms. The "potholes" on the face of the rocky bed forming the rapids were stated to have been caused by stones being caught and retained by the eddying current until holes were worn into the rock.

On the return from the waterfall Professor Tate pointed out the curious parasite, *Cassytha pubescens*, festooning *Acacia retinodes*, and drew attention to the sedge *Cladium psittacorum*, the tallest of its kind in Australia. At five o'clock the Section left Bridgewater, and reached the city shortly after six.

Sixth Excursion—April 6, 1885 (Easter Monday).—Highercombe.

About thirty-five members and friends proceeded to Highercombe, the party being led by the Rev. J. McEwin. On approaching the hills the different character of their vegetation, some giving light and others a dark tinge, was pointed out. This was explained to be due to the habitat, chiefly determined by the soil and underlying rocks; the dark hills (on which grew shrubs and sedges) being formed of sandstones and other silicious rocks, while the light-tinted hills, which were mostly covered with grass, were composed of shales and slates. The superposition of the Tertiary clays and gravels upon the older rocks at the foot of the hills was also pointed out. The Eucalypti were also noticed to differ from those further south.

On arriving at Highercombe the party visited the beautiful gardens and grounds of the Hon. R. D. Ross, who very kindly granted permission to inspect his property, the chief feature of which was the number of English forest trees. After luncheon the Hon. R. D. Ross led the party to a picturesque gorge, which was about fifteen feet wide, its perpendicular rocks rising some 200 feet above the river. After leaving the gorge and following up the creek back to the gardens, there were found *Callistemon saligna*, *Leptospermum lanigerum*, forming dense thickets, among which were found *Correa decumbens*. A tuft of *Andropogon lanigerum* was also found, and some rare mosses and lichens on the rocks; the latter consisted of quartzose and talcose schists and shales, inclined at rather high angles.

The season being so far advanced, very few flowers were observed. On the way back from the gorge the party visited the "Echo," a face of rock rising some 300 feet above the river.

The coach was reached about five, and the party, after par-

taking of Mr. Ross's hospitality, left at 5.30, the homeward route being *viâ* Anstey's Hill and through Paradise.

Seventh Excursion—April 18, 1885.—Second Gully.

About twenty members and friends proceeded to Burnside, Mr. G. Collis, Jun., acting as Secretary, and Mr. J. G. O. Tepper, F.L.S, and Mr. W. Howchin, F.G.S., being the scientific instructors. Shortly after leaving the tram attention was called to a peculiar hard and coarse conglomerate exposed on the bank of the creek. Mr. Howchin expressed the opinion that it was an ancient remnant of the gravel of the local watercourse, when the stream flowed at a considerably higher level. The party then ascended the Greenhill, where two very distinct varieties of *Vittadinia australis* were pointed out. Mr. Tepper directed the attention of the members to the distinct zones of Eucalypts. The relation of the vegetation of the hills to the rocks of which they were composed was referred to in order to show that from the aspect of vegetation conclusions as to the prevailing but hidden rocks could be drawn, just as from the known existence of certain rocks the character of the plants could be inferred.

The view from the top of the hill having been admired, the gully below them, with its steep scrubby declivities and perpendicular weathered cliffs was the object of attraction. On the steep side of the Greenhill some bushes of the South African *Gomphocarpus fruticosus* were found perfectly naturalised. The diœcious character of the sheaoak (*Casuarina quadrivalvis*) was pointed out, and the junction of the two species of grasstrees (*Xanthorrhœa semiplana* and *X. quadrangulata*) was well shown at one place, the former extending from the spot downwards and the latter upwards. In the bed of Slape's Gully Mr. Tepper pointed out a native grass (*Ehrharta stipoides*) as being eminently suitable for lawns. The *Epacris impressa* was found to be just in bloom, other plants in flower being *Wahlenbergia gracilis* (bluebell), *Oxalis corniculata* (yellow), *Styphelia Sonderi* and *S. humifusa*, *Scævola microcarpa*. *Bursaria spinosa* had but few flowers, but more fruit. The following ferns were noticed:—*Cheilanthes tenuifolia*, *Grammitis rutæfolia*, *Lomaria capensis*, *Asplenium flabellifolium*, and a few early specimens of Maidenhair (*Adiantum æthiopicum*).

Eighth Excursion—Saturday, May 16, 1885.—Port Creek.

Owing to the threatening weather only a few members attended this excursion. On arrival at Alberton the party

proceeded under the guidance of Professor Tate in a southerly direction, and shortly after crossing the Port-road struck a course for the Port Creek. A short business meeting was held *en route*, and a new member elected. On nearing the creek attention was called to the *Scirpus nodosus*—a rush-like sedge, the roots of which bind the drifting sand. On reaching the mud-flats, the tide being low, a good opportunity was afforded in searching for molluscs under the salsolaceous bushes. Here were found *Ampullarina Quoyana*, *A. fragilis*, and *Pomatiopsis striatulus*, and the following plants in flower:—*Atriplex semibaccata*, *A. paladosa*, *Kochia brevifolia*, *Frankenia lævis*. Further inland a permanent pool of water was visited, and proved to be exceedingly rich in molluscan life, amongst which were species of *Bittium*, *Tatea*, *Bythinella*, *Trochocholea*, &c., these being entangled in tow-like confervæ. Several *Isopods* and other crustaceans were also found. In the same water were seen several sea anemones of a brown colour, with dark bands across the tentacles, their existence in this locality causing considerable astonishment. The following plants were met with on the sandhills:—*Wahlenbergia gracilis*, *Erechtites quadridenta*, *Salsola kali*, and *Xerotes effusa*. The mangrove (*Avicennia officinalis*) was observed to be in flower.

Ninth Excursion—Monday, May 25, 1885.—Marino.

Some fifty members and friends started by the 9.5 a.m. Glenelg train in reserved carriages. Alighting at Miller's Corner, the party found a special tramcar waiting to take them to Brighton. On the road leading to the beach, and at the edge of the sand-dunes, attention was called to a thick growth of the Sarsaparilla (*Muehlenbeckia adpressa*). Just opposite to this a halt was called, when Professor Tate stated that they were evidently on the edge of a low escarpment consisting of red loam, in which were to be found pebbles and marine shells, such as whelks and the valves of the mactra, these being thrown up by the action of the waves. At no distant period the land had increased owing to the piling action going on in the formation of the sand-dunes. The red loam referred to projects out to the sea, and explains the existence of fresh-water springs, these being the drainage from the sandhills kept in its place by the clayey soil. Mr. Luxmoore, whose residence adjoins the road on which the party were gathered, invited them to go on to his property, where could be seen a large number of the pebbles previously referred to, their presence having caused some perplexity to the owner, who thought they might have been placed there by human agency. The

locality did not possess the constituents of a raised beach, and the only feasible explanation of these pebbles getting into their present position was to be found in the force of the breakers carrying them there. It was remarked in this connection that the land hereabouts was gradually encroaching on the sea, and the "gathering" action could be plainly noticed. Arriving on the beach the potash-plant (*Salsola kali*) was noticed, from which the potash of commerce was formerly obtained. This plant is generally found inland in dry saline country, and is not often seen on the seabeach. Leaving the beach for a moment, the party were taken to the foot of the sandhills to inspect a pool of fresh water. Returning to the beach the party resumed the walk. A portion of the beach was soon reached, which was stated to be a good collecting ground (after rough weather) for the conchologist, and a little further on a few scattered stones of an angular shape were noticed, the reason for their not being smooth was that they were not sufficiently numerous to rub against each other. Soon the shingle beach was arrived at, and beyond this the rocks. Having traversed this uncomfortable locality (so far as walking is concerned) for a short distance, the party halted, and the Professor directed attention to what was evidently an anticlinal axis, the strata at this part dipping in opposite directions, that to the south-east being the most plainly marked. The rocks found here, he stated, were amongst the oldest in Australia. An *al fresco* luncheon was then partaken of, after which the party walked up one of the ravines so numerous in this locality, and were afforded an opportunity of inspecting *in situ* the crystalline limestone, from which material it had been attempted to make Portland cement, but on account of its silicious nature it was unsuitable for the purpose. On the sides of this gully several interesting botanical specimens were met with, amongst which may be mentioned the grass *Pappophorum commune*, which is not often found in these parts, its favourite haunts being in the North; *Boerhaavia diffusa*, *Sida corrugata* (a desert species). Emerging from the ravine, a course was shaped in a westerly direction, and the hills forming the terminus of the foothills, Mount Lofty Range, which here trend towards the coast, were next explored. In these parts the sweet-smelling *Xerotes effusa*, the ubiquitous *Wahlenbergia gracilis*, and *Styphelia patula* were found. The carnivorous plant (*Drosera Whittakeri*) excited much attention, and a leafless shrub took some time to identify, the *savans* of the party holding different opinions on the subject. It was eventually pronounced to be *Exocarpus aphylla*, but its close resemblance to *Leptomeria* rendered identification difficult in its present state. Amongst other plants which may be recorded as found here may be mentioned *Grevillea lavan-*

dulacea, *Scleranthus pungens*, *Senecio odorata*, *Calocephalus Brownii*, *Rhagodia Billardieri*, *Alyxia buxifolia*, and the poisonous *Euphorbia Drummondi*. A few flowers of the beautiful *Hakea rugosa* were gathered. One, and one only, of the orchids was noticed, this distinction falling to *Pterostylis mutica*, and this was not in flower. Having thus enriched their botanical collections, the party returned to the rocks near which they had taken their luncheon in the morning, and shortly after 2 o'clock started on the homeward journey. They had not proceeded far when attention was called to what seemed the remains of an old beach near the top of the cliff. Prof. Tate explained that it belonged to the Older Tertiary period, and that similar beds had been seen in greater force at Hallett's Cove (three or four miles further down the coast), when the Section had paid that place a visit some time ago.

Leaving this interesting section, search was made for a well which was said to be in the vicinity. Ere long a spring was noticed, but its water was too brackish to be palatable. Next came what was perhaps the hardest piece of climbing done during the day, viz., the ascent of the high hill in front of the house formerly occupied by the late Sir George Kingston. From the summit a magnificent view was obtained.

The party, after a short rest, resumed their walk in a direct line for the tram stables, and on arrival there found a tramcar waiting, which started in time to meet the 5 o'clock train from Glenelg, the city being reached at 5.30.

Tenth Excursion—Saturday, June 13, 1885.—Botanical Gardens.

It was arranged that the Section should pay a visit to the Gardens on this date, but owing to the almost incessant downpour of rain only about half a dozen members put in an appearance. These spent the afternoon in the "Museum of Economic Botany," and were much pleased and interested with the admirable collection of botanical products which Dr. Schomburgk has arranged in this building.

Eleventh Excursion—Saturday, July 11, 1885.

This date was fixed for a visit to the Zoological Gardens, but the afternoon proved exceedingly wet; and as only a few members attended, no meeting was held.

Twelfth Excursion—Saturday, August 15, 1886.

It was intended to make an excursion to the Grange on this date, but, as in the case of the two previous meetings, the inclement weather frustrated the plans of the Section. A few members carried out the programme, and collected on the beach a large variety of algæ, shells, sponges, sea-eggs, &c., which had been washed up by the recent rough weather.

Thirteenth Excursion—Tuesday, September 1, 1885.—Hallett's Cove.

Between forty and fifty members and friends proceeded to Hallett's Cove. Shortly after nine o'clock a start was made from the Town Hall, the route lying through Edwardstown and the Sturt, where a short stop was made prior to ascending Tapley's Hill. The gentlemen dismounted from the vehicles and walked up the steepest part of this gradient, noting as they went the slaty rocks and quartzites of which this hill is mainly composed. Arriving at the summit, and just after passing the ten-mile post, the road to the right was taken, which leads to O'Halloran Hill. Another turn—this time to the left—and then an almost direct course to Hallett's Cove was shaped, the destination being reached at about half-past eleven. Dismounting, the party made for Field's River, on the banks of which luncheon was partaken of. This part of the day's proceedings over, the Honorary Secretary (Mr. W. H. Selway, jun.) assembled the party, and explained the programme of the day's operation. Under the guidance of Mr. J. G. O. Tepper, F.L.S., a southerly direction was first taken, and the coast cliffs explored for flowers, which were seen in great profusion. The peculiar flora of this locality very closely resembles that of the opposite coast of Yorke's Peninsula. Approaching still nearer the coast, the members hoped to find some rocks giving evidence of glacial action, but, as these were further off than was thought, it was resolved to strike a direct course for a point some distance up Field's River, passing over a good deal of rough country on the way thither. The river was ascended for a short distance, and the stratigraphical formation of its picturesque cliffs was viewed with much interest. These were noticed to consist chiefly of masses of limestone, shales, and sandstones, very curiously crumpled, and with slaty bands occasionally interstratified. The watercourse was found to be almost covered with a species of *chara*, and among the reeds and rushes were noticed an unusually large form of *Apium prostratum* and the tall *Triglochin procera*, both in flower. One or two gentlemen who had gone to the beach returned with some very fine specimens of starfish, one especially being

of immense size and very beautifully marked. In two or three places the party found some very large boulders of granite, for the presence of which amongst the general geological features of the locality they were unable to account, except upon the hypothesis that they were glacial erratics.

After a short rest a start was made for the north side of the Cove to inspect the rocks about half a mile distant which created such interest on the previous excursion, viz., those on which the signs of ice action are to be found. The polished and striated face of the rock was shown, and those geologists of the party who had seen similar and undoubted marks of ice action in England agreed that Professor Tate, who discovered this rock, was quite justified in assigning them to the agency indicated. It was intended to search for fossils in the Tertiary beds on the way back to the coaches, but there was not sufficient time for this.

During the day the following plants (generally found only in mallee country) were collected in flower, viz.:—*Erysimum brevipes*, *Pittosporum phillyriæoides*, *Claytonia calyptrata*, *Mesembrianthemum æquilaterale*, *Enchylæna tomentosa*, *Ptilotus spathulata*, *Muehlenbeckia adpressa* (Native Sarsaparilla), *Zygophyllum fruticulosum*, var. *angustilobium*, *Stackhousia linarifolium*, *Pultenæa tenuifolia*, *Swainsonia phacoides*, *Glycine clandestina*, *Kennedya prostrata*, *Acacia spinescens*, *Tillæa macrantha* and *T. purpurescens*, *Hydrocotyle callicarpa*, *Pimelea curviflora* and *P. glauca*, *Grevillea lavandulacea*, *Hakea rugosa*, *Minuria leptophylla*, *Brachycome pachyptera* (both very pretty white starlike flowers), *B. tenella*, *Craspedia Richea* (the "Billy Button"), *Podolepis acuminata* (one of our largest-flowered composites), *Microseris Forsteri* (native yam), *Leeuenhoekia dubia*, *Velleia paradoxa*, *Bulbine bulbosa*, *Xerotes glauca*, *X. nana*, *Schœnus Brownii*, *Dampiera rosmarinifolia*, *Logania linifolia*, *Nicotiana suaveolens* (native tobacco), *Euphrasia Brownii*, and *Westringia rigida*. Of Orchids the following were gathered:—*Diuris palustris*, *D. pedunculata*, *Caladenia Patersoni*, *C. latifolia*; and three varieties of ferns, viz., *Ophioglossum vulgatum*, *Cheilanthes tenuifolia*, and *Grammitis rutæfolia*.

The party assembled at the coaches shortly before five o'clock, and after an enjoyable drive reached the city at 6.45.

Fourteenth Excursion—Saturday, September 12, 1885.—Magill and Horsnell's Gully.

On Saturday, September 12, an excursion to Magill and Horsnell's Gully was made by about 20 members and friends, this being the first visit by the Section to that part of the

hills. The party left the city at 1.10 p.m. in a special tramcar, and, on arriving at Magill, started to walk up the Norton's Summit road, under the guidance of Professor Tate, F.G.S., F.L.S. They had not gone far when attention was called to a bed of conglomerates on the right-hand side of the cutting. These were resting on the upturned edges of slates, and probably indicated the recession of a former watercourse, the present channel not being far away, but at a considerably lower level. Resuming the walk the first flower gathered was soon afterwards found, viz., *Scævola microcarpa*, one specimen of which possessed additional interest on account of having a gall attached to its stem—a phenomenon somewhat rare on this plant. Attention was next called to the silver wattle (*Acacia retinodes*), which was in fruit, and on the leaves of which tree numerous galls were also seen. After walking a little farther, the road branching off to the right and leading to Horsnell's Gully was taken. Flowers here were very numerous, one of the first to attract notice being the pretty white *Logania longifolia*, while the beautiful light-yellow clusters of *Clematis microphylla* divided the honours with the first-named. *Glycine clandestina* and *Sherardia arvensis* were also collected here, and one or two flowers were already noticeable on the *Banksia marginata*. Attention was called to the poisonous *Swainsonia lessertiifolia*, which has acquired some notoriety on account of having caused the death of sheep in the South-East. The delicate white and spotted flowers of *Myoporum viscosum*, with its rich dark-green foliage, had a great many admirers. After considerable search a few specimens of *Corysanthes pruinosa* were discovered, but none in flower. Attracting notice from its brilliant yellow flowers, *Pultenæa daphnoides* was soon added to the collection. After passing a bank thickly covered with Cape Broom in bloom (*Genista canariensis*) the party arrived opposite a very fine and somewhat pyramidal-shaped bluff of rock composed of sandstones and grits, and near here in a pleasant shady spot a short rest was indulged in. A few of the party scaled the hillsides, and found three kinds of orchids, namely—*Pterostylis nana*, *Diuris maculata*, and *D. pedunculata*, there being a little doubt, however, as to whether the last of these was correctly named or not. Two other orchids gathered during the afternoon were *Pterostylis curta*, with its curious hooded appearance and green flower, and *Caladenia Patersoni*. Near the resting place was observed *Kennedya prostrata*. *Kennedya monophylla* (native lilac) was also abundant. Their energies sufficiently recruited, the party continued the walk in the same direction, amidst picturesque scenery. Soon were observed the myrtle-leaved wattle (*Acacia myrtifolia*) in bloom, and the sweet-

scented mauve-coloured flowers of *Tetratheca ericifolia*. Mr. J. G. O. Tepper, F.L.S., here directed the attention of members to a curious tuft-like proliferation found growing on a eucalypt, and said that the part of the tree above this growth subsequently dies. He stated that the cause of it was at present unknown, but that it was well worthy of investigation by scientists, pointing out that to the successful discoverer distinction was almost certain. The carnivorous sundew *(Drosera Whittakeri)* was rather plentiful. The following ferns were gathered, viz. :—*Adiantum æthiopicum* (maiden hair), *Cheilanthes tenuifolia* (the common rock fern), *Lomaria discolor*, and *L. lanceolata*, *Grammitis rutæfolia*, and *G. leptophylla*. It was now considered time to turn back, and not wishing to scale the precipitous hills by which they were surrounded, the party determined to return by the way they had come, a few members examining the creek *en route* in search of mosses, &c. Amongst other flowers, not previously mentioned, which were collected were *Cæsia vittata*, *Goodenia geniculata*, and *Stackhousia linarifolia*. The excursionists, each laden with floral treasures, returned from Magill by the 5.15 tram.

Fifteenth Excursion—Saturday, October 10, 1885.—Highbury.

On Saturday, October 10, about thirty ladies and gentlemen proceeded to Highbury, starting from town at 1.40 p.m., in one of Hill & Co.'s coaches. On arrival at Highbury a start was at once made under the guidance of Prof. Tate, F.G.S., F.L.S. into the scrub to the south of the road. After walking about 100 yards an excavation was reached, and this being a convenient place to point out the geological features of the locality a short stoppage was made. Having disposed of some formal business, Professor Tate addressed the members, and stated that they were on a little patch of scrub which had lost some of its characteristics by over-cropping. This scrub land was very limited in its extent, and was a remnant of a considerable sheet that extended all along the foot-hills of the main range, and was seen in stronger force at Golden Grove, to the north of which still larger patches were met with. These patches were generally recognised externally by the sanddrift that surrounded and covered them, and beneath which the rock was seen to be mostly of a soft mottled sandstone in horizontal beds, as in that particular pit near which they were standing. A few yards from this was a stone quarry showing the fundamental rocks lying at high angles, almost perpendicular in fact. This dissimilarity in inclination served to

establish the superposition of the mottled sandstones to the slates. The basal part was made up of sub-angular gravel, of which the auriferous cement rock of Humbug Scrub was an example. These, continued the Professor, were considered to be of fluviatile origin, and might be the terrestrial equivalents of the marine Miocenes seen at Government House quarry and Hallett's Cove. With the exception of a few shrubs, the large majority of the very varied plant species found in the neighbourhood were, in regard to duration, ephemeral. This seemed to be owing not so much to the quality of the soil as to its non-retentive property for water, and consequently there could only be exuberance of vegetable life when the surface was saturated. From these circumstances the greatest richness was about the margin of these Tertiary patches, and it was there chiefly that search for orchids would be directed.

The party then moved off in a southerly direction, and commenced to make their floral collections. This they experienced no difficulty in doing, as flowers were to be seen in great profusion wherever the eye turned. Although not the orchid-ground proper, yet some of these lovely flowers (chiefly the Caladenias) were gathered on this scrub land. That very beautiful dark-blue flower *Chaemascilla corymbosa* was also met with here. Ere long a sharp turn to the left was taken in order to reach the edges of the Tertiary patches, where Prof. Tate had indicated that orchids would be found. Such indeed proved to be the case, and several varieties were secured, viz., *Thelymitra aristata* (or *nuda*), *T. longifolia*, *T. McKibbinii*, *T. antennifera*, and last, but by no means least, *T. grandis*, which attains a height of three feet, with a spike of numerous flowers, which is seldom less than twelve inches in length. Of Caladenias the following were observed:—*C. Menziesii* and *C. Pattersoni*, with two or more of its sub-species. Other orchids collected comprised *Prasophyllum patens* (or *fuscum*), with its small white flowers; *Microtis porrifolia* (small green), *Glossodia major*, the flowers of which are of a purple colour.

Leaving the orchid ground, a course was struck for the aqueduct coming from the Torrens weir. On the way a discovery of an interesting little plant was made. This was *Calocephalus Drummondii*, a Western Australian species, but found in a few localities in this colony, its discovery in the latter having been made by Professor Tate at Highbury. The main road was now struck, and shortly afterwards the coach was reached.

The following are some of the plants found on this excursion, viz.:—*Dichopogon strictus*, *Brunonia australis*, with its bright blue spiky heads, *Chaemascilla corymbosa*, *Cheiranthera linearis* (dark blue), *Lotus australis*, *Pimelea humilis*, the thorny

Hakea rugosa, *Euphrasia Brownii*, and the very minute *Helipterum exiguum*, *H. pygmaeum*, and *Leeuenhoeckia dubia*. Worthy of mention is *Linum marginale* (native flax), which is remarkable in being at times affected by a gall, this being the only instance known in the world of a gall being found on a flax. One plant of the order Euphorbiaceæ was noticed, viz., *Poranthera microphylla*, which is a small poisonous species. Of the Leguminosæ may be cited *Eutaxia empetrifolia*, a small shrub literally covered with yellow flowers; *Dillwynia hispida* (dark red), and *Swainsona procumbens* (scarlet). Two varieties of *Vittadinia australis* (white and purple) were seen, which differed greatly in the form of leaf. These belong to the Compositæ, of which order *Podolepis rugata* (in bud only), *Leptorrhynchus squamatus*, *Senecio lautus* and *Microseris Fosteri* (native yam) were also gathered. Amongst a lot of other flowers more or less interesting may be mentioned *Velleia paradoxa*, *Goodenia geniculata* (both yellow), *Scævola microcarpa* (bluish white) *Cynoglossum suaveolens*, *Dianella revoluta* (blue), *Bulbine bulbosa* (yellow), *Thysanotus Patersoni* (a purple climber), *Calycothrix tetragona* (a delicate pink flower growing in very thick clusters), *Leptospermum myrsinoides*, and *Grevillea lavandulacea*. *Daucus brachiatus* (which is commonly called the native carrot, but which has no thickened root) was also found. This plant extends over the whole Australian continent. There were two Acacias, namely, *A. obliqua* and *A. myrtifolia*, the latter just out of bloom.

Shortly after 5 o'clock the coach left the Highbury Hotel, arriving in town about an hour later.

Sixteenth Excursion — Saturday, October 24, 1885.— Government Farm.

The first of two extra excursions arranged for the month of October was held on this date, when about forty members and friends left by the 1.10 p.m. train for Belair. On arrival there a course following the railway line in a westerly direction was first taken, Professor Tate leading the way. After walking for about three-quarters of a mile a halt was called, and a short meeting held. Dr. Cleland (Chairman of the Section) presided. Two new members were elected. The meeting over, Professor Tate stated that he wished to take the geologists to a railway cutting a little further on, and invited those who took an interest in geology to accompany them. Those who were botanically inclined he recommended to search in that portion of the scrub land of Government Farm near which they were standing, and it was arranged that both parties should subsequently rejoin each other. Accordingly the party

separated, the majority favouring the study of botany. On arriving at the cutting to which reference has been made Professor Tate explained that this was a small patch of diluvial formation, consisting of sandy clays with sharp gravel underneath, and occasionally cemented by a ferruginous layer of hard rock overlying uncomformably the decomposing sandy slates. It might be regarded as a portion of the same series as they had seen at Highbury a fortnight ago. He drew the attention of the members to the contour of our hill slopes, as being such as would not result from atmospheric denudation, which tends to bring into relief the hard bands, whereas in the case of our hills the hard and soft were smoothed down to one uniform curve. The Professor then took the opportunity of making his hearers acquainted with the last phase of the controversy touching the glaciation of Australia. As bearing on the question under discussion, Mr. D. B. Adamson referred to Croll's theory as to climatic changes being due to the shifting of the earth's axis, remarking that astronomical facts did not justify this conjecture. The geologists then continued to walk along the railway line as far as a very high embankment at the entrance to a beautiful little glen. This latter, about a quarter of a mile from the embankment, is closed by lofty walls of rock, about seventy or eighty feet high in parts, a waterfall of small dimensions flowing over the extreme end. To this the party wended its way, and on arriving there the formation of waterfalls was discussed. It was pointed out that in the case of the one before them, the walls of which were composed of grit-bands, a very large mass of rock must have been washed away, and that the present flow of water was not competent to have caused this. As the erosive action progresses the waterfall itself continues to gradually lessen in height because of the inward high dip.

Mr. J. G. O. Tepper acted as guide to the botanical party, who directed their energies to that portion of Government Farm which had been recommended. The most striking feature here was the shrub *Leptospermum myrsinoides*, which was covered with its white flowers, suggestive of a fruit blossom. Attention was directed to the female pistillate flowers of the *Casuarina distyla*. This part of the hills is noted for its orchids, and several varieties were gathered. A very interesting discovery of an orchid not previously found in these parts was also made, viz., *Calochilus Robertsoni*, which is met with in the South-East, and two years ago was seen at Maclaren Vale, but previous to the date of this excursion was not known at Government Farm. A remarkable feature of this orchid is its lip, which is covered with dense hair, and presents a most peculiar appearance. Other orchids found during the afternoon were *Thelymitra*

longifolia, *T. antennifera*, *Microtis porrifolia*, *Prasophyllum patens*, *Pterostylis barbata*, *Caladenia Menziesi*, *C. dilitata*, and *Glossodia major*, three distinct colours of the last-named being noticed, including a pure white one. Two or three kinds of Droseras were seen, and their insect food pointed out. Those very minute flowers *Stylidium despectum* and *S. calcaratum* were gathered. The latter of these, in some points, is not unlike the *Polypompholyx tenella*, which is supposed to be carnivorous, and contains a sweet secretion which is thought to lure insects to their destruction. *Isopogon ceratophyllus*, *Helichrysum scorpioides* and *H. Baxteri* were collected. Growing near a watercourse were the small pink *Lythrum hyssopifolia* and the native flax (*Linum marginale*). The pink *Erythræa australis*, which in the summer months is seen in abundance in many parts of the colony, was already in flower, and is noted for its tonic properties. A little way up the glen was seen a rich bank of maidenhair fern (*Adiantum æthiopicum*), and in a short time the waterfall was reached, where the other party were enjoying a rest, and in which they were now joined by the botanical section. On discussing results Professor Tate reported that he had found a very rare plant, viz., *Euphrasia scabra*, which is an annual, and very local, this being the first time the Professor had met with it. Near the waterfall the rarer plants noticed were *Verbena officinalis*, *Siegesbeckia orientalis*, *Cynoglossum suaveolens*, and *C. australis*. When their energies had been sufficiently recruited the whole party started on the homeward journey, following much the same course as that by which the botanical division had come. Returning to the pasture-land, *Brachycome diversifolia*, *Ajuga australis*, and *Pultenea pedunculata* wers collected, while the banks were gay with the white Stichwort (*Stellaria glauca*). One or two members, who had not gone as far as the others, had found *Veronica Derwentia*, which had not been met with by the rest of the party. On the way back the sedge (*Schœnus Tepperi*), discovered by Mr. Tepper on Yorke's Peninsula, was noticed. Amongst other flowers not previously mentioned which were gathered may be noted *Dillwynia hispida*, *Tetratheca ericifolia*, *Euphrasia Brownii*, *Lavatera plebeia*, *Brunonia australis*, *Cheiranthera linearis*, *Scævola microcarpa*, and *Burchardia umbellata*.

The party reached the Belair Station in time to leave by the 5.36 train, having spent a very enjoyable afternoon.

Seventeenth Excursion—Saturday, October 31, 1885.—Stonyfell.

This day, like several of the previous dates fixed for excursions, proved exceedingly wet; but notwithstanding this 20

members and friends proceeded to Stonyfell, leaving by the 2 p.m. car for Burnside. Just after reaching the Burnside-road, and opposite the house of Mr. J. Stuart Sanders, the car stopped, and guided by Mr. J. G. O. Tepper, the party turned into an open section on the eastern side of the road, and started on their walk in the direction of the hills. They had not proceeded far when a spring was noticed, around which were growing various forms of vegetation. Whilst examining this Mr. J. S. Sanders, who had espied the party from his house adjoining the section in which they were walking, came up and invited them to go into his grounds. He mentioned that the spring near which they were standing was running all the year round. Professor Tate explained that this was due to its gravel bed resting on a subsoil of clay which retained the water, the clay being coterminous with the edge of the spring. Around the spring were found the following plants:—*Stylidium despectum*, *Cyperus tenellus*, *Tillæa macrantha*, *Juncus cæspititius*, and *Scirpus riparius*. Mr. Sanders then showed the party over his extensive and well-kept garden. A portion of Mr. Sanders's property is still kept in its natural state, and several indigenous flowers were gathered there, amongst others *Helipterum dimorpholepis*, *Grevillea lavandulacea*, *Hibbertia densiflora*, *Velleia paradoxa*, *Dianella revoluta*, *Linum marginale* (native flax), and *Calycothrix tetragona*. The shrub *Bursaria spinosa*, was also noticed, but its usual characteristic, the spines, was absent. Before leaving the grounds of Mr. Sanders a short meeting was held, and a new member elected. A hearty vote of thanks was passed to Mr. Sanders for his kindness to the Section. The party then continued the walk up the slope, where the following were collected, viz., *Styphelia humifusa* (the cranberry), *Isoetopsis graminifolia*, *Calocephalus Drummondi*, *Podolepis Siemssenia*, and *Ptilotus erubescens*. A somewhat rare plant found here was *Goodenia amplexans*, which also grows at Hallett's Cove and one or two places in the Mount Lofty Range. After crossing the road at the back of Mr. Newland's house, that tertiary patch of country was reached to which Mr. Tepper recently referred in a paper read before the Section. The drift material seems to extend higher up the slopes here than at any other part along the range. This particular place is perhaps the nearest to town, and the most accessible site for obtaining similar plants to those growing on the higher elevations of the Mount Lofty Range. Some of those, also, that are met with here are not found on any other part of the range. When ascending this hill a shower of rain detained the party for some time, during which they took shelter behind some small gums (*Eucalyptus leucoxylon*). This gave an opportunity for calling attention to the *Eriogasta*,

one of the *Coccidæ*, which attacks these trees, and was seen in thick clusters on the branches. This parasite is a favourite article of diet with ants, which extract nourishment from a small hole in the shell which surrounds it. The ants, however, do not kill the *Eriogasta*, and the tree eventually dies. The rain over, the walk was resumed, and soon Stonyfell was reached, on the right of which is a quarry and on the left Mr. Crompton's vineyard. A road has been made as far as the quarry, beyond which the hill is exceedingly wild and rugged, and progress very difficult. The most noticeable botanical feature about here on Saturday was *Prostanthera Behriana*, the beautiful flowers of which excited great admiration. After careful search *Anthocercis angustifolia* was found, a plant which is restricted to only a few localities in South Australia and is found nowhere else in the world. Other plants collected at Stonyfell were *Dodonæa viscosa*, *Grevillea lavandulacea*, *Pimelea humilis*, *Pultenæa acerosa*, *Acacia continua*, *Senecio hypoleucus*, and *Ixodia achilleoides*, the last-named being the small white flower which is used for making funeral wreaths. After a short rest amidst the picturesque scenery at the head of the gully, the party walked back to Kensington, returning thence by tramcar to the city, which was reached about 6.30.

———o———

EVENING MEETINGS.

First Evening Meeting—Tuesday, May 19, 1885.

On this evening Mr. J. G. O. Tepper, F.L.S., was to have read a paper on "Local Orchids," but owing to the small attendance the reading was postponed till June 23.

Mr. Somerville brought for exhibition a specimen of a resinous substance which exudes from a species of grass-tree found in New South Wales (*Xanthorrhæa hastilis*), and which it was thought might become a useful article of commerce. It was mentioned that a shipment of it had been sold in London for six shillings and seven shillings per hundredweight, and that a somewhat similar exudation had been noticed by Prof. Tate, F.G.S., F.L.S., on Kangaroo Island.

Second Evening Meeting—Tuesday, June 16, 1885.

There was a good attendance; Professor Tate, occupied the chair. Four new members were elected. Mr. W. E. Pickels (the Secretary), who was one of the founders of the Section, tendered his resignation on the ground that his frequent ab-

sence from town interfered with his duties. His resignation was accepted with regret, and a motion to that effect was carried. The resignation of Mr. G. F. Hussey as a member of the Committee was accepted in similar terms, and Messrs. W. J. Sowden and G. G. Mayo were elected to fill the vacancies in the Committee. Mr. W. H. Selway, jun., was elected Hon. Secretary.

The Chairman brought under the notice of the Section a periodical started by Mr. Joseph Wing in Victoria, and called the *Southern Science Record*, which he strongly recommended.

The Chairman stated that no representative of *Cordiceps* or *Torrubia* (vegetable caterpillar) is recorded for South Australia, but in digging at Nairne he found what he believed to be a *Cordiceps* parasitic on the larva of a beetle, and this he exhibited.

Mr. Tepper said he believed a *Torrubia* of a large size, some four inches long, occurred near Alice Springs.

The Chairman also showed some specimens submitted to him by a gentleman in Tasmania, who believed them to be slugs. They have a general resemblance to the liver-fluke, but there are two little tentacles springing from the upper surface. He could not claim them as slugs, but thought they might turn out to be land *Planaria*.

Mr. G. Beazley, the Museum taxidermist and articulator, then gave some practical illustrations in the art of preparing birds for stuffing.

THIRD EVENING MEETING—TUESDAY, JUNE 23, 1885.

Mr. G. Collis presided. There was a small attendance. Mr. Grasby exhibited about forty-four varieties of mosses and lichens from the banks of the River Onkaparinga at Oakbank. They were collected by the local school children in the course of an outdoor excursion under the guidance of Mr. Grasby.

Mr. Tepper exhibited a lampglass with marks upon it, giving it the appearance of being cracked, when in reality it was perfectly sound. The seeming flaws were in his opinion formed either by minute fungi or the action of saline matter from the dampness of the straw in which the glass was packed. Mr. Tepper then gave his lecture on "Local Orchids," and, with the assistance of diagrams, explained the peculiar nature and beauties of the plants, pointing out the structure of the flowers, which in all their multifarious variety exhibited the same general ground plan. He said there were thousands of species distributed over almost the whole land surface of the earth. In Australia 255 species in forty-six genera were recorded by Sir F. von Mueller, of which seventeen, with fifty-three species,

were noted from this colony, but probably more existed. Some forty-nine species and varieties have been collected by Mr. Tepper in the neighbourhood of Adelaide, chiefly about Clarendon. A short discussion ensued, and Mr. Tepper mentioned the localities where different varieties of orchids could be found, such as Stonyfell, Clarendon, Kensington, and Government Farm, and he said sandy deep ground was favourable to the flower.

Fourth Evening Meeting—Tuesday, July 14, 1885.

Professor Tate occupied the chair. There was a moderate attendance. One new member was elected. Dr. Magarey exhibited some shells. Professor Tate gave the names as *Obeliscus brunnea*, a rather rare shell, from Glenelg; *Anatina gracilis* and *Marcia faba*, from the mouth of the Onkaparinga; and *Columbella bidentata* and *Mitra Tatei*, from Salt Creek; the first had not yet been catalogued as a South Australian shell. Mr J. G. O. Tepper showed an interesting collection of South Australian seaweeds. Professor Tate showed fossil teeth of *Ceratodus*, found in the central lake region of Australia, associated with remains of the *Macropus atlas*; a toe and bones of an emu-like bird, crocodilian remains, and part of the bony carapace of the turtle. It seemed highly probable that the fish belonged to the same species as that living in Queensland, *C. Fosteri*. In 1872 Mr. Krefft found the teeth of the *Ceratodus* in the conglomerate in the basin of the Condamine River, in North Queensland, which he considered to be of an extinct species, and last year Mr. De Vis, curator of the Brisbane Museum, found specimens in another locality, and considers that they are not different from the living species. Professor Tate thought from these evidences that his speculations on the existence of a large fresh-water area in Central Australia were proved to be correct.

Mr. W. Howchin, F.G.S., then read a paper on "Storms and Weather Charts." The lecturer dealt with the construction and uses of the barometer, with special reference to its application to meteorological science. The laws regulating storm phenomena were explained by means of the blackboard, and large diagrams were used to illustrate the hydrography and principal storm tracks as observed in Australia. The isobaric lines and signs used in the delineation of weather charts were interpreted, and some useful observations were given bearing upon Australian climatology. The storms which occur over the southern half of Australia, the lecturer remarked, almost invariably pass from west to east, first making themselves felt in Western Australia, skirting the coast with their centres well off the

land, and pass over Tasmania and New Zealand. The gathering area of these storms is probably the southern portions of the Indian Ocean, following the lines of atmospheric currents and condensation of vapour, they impinge on the south-western limb of the continent, where they are turned southwards by the anti-cyclonic conditions which normally prevail on the land. Hugging the shore they pass eastwards, and usually gather intensity as they approach the eastern limits of the continent, probably reinforced by aqueous currents flowing southwards along the eastern coastline. This intensifies the barometrical depression, whilst the area of the storm widens out, heavy gales are experienced in Bass Strait and over the adjacent coasts, spending their greatest force upon Tasmania and New Zealand. A few of our storms come up from the Southern Ocean, or have a retrograde motion from the east westwards, but these are very exceptional instances. The average rate at which storms travel may be given as about sixteen miles an hour, or 400 miles in the twenty-four hours. But this is a very uncertain feature. A storm centre may hang over a given region for several days together, or it may move forward, slowly or rapidly, without any apparent cause for such irregularity of movement. It generally takes from two days to a week for a storm to pass from the Leuwin to Adelaide, and about twenty-four hours more to reach Melbourne. The diameter of storms is seldom under 600 miles from lip to lip of the depression, but they are often vastly larger, taking in the whole of Europe, or stretching from Australia to New Zealand in one vast turmoil of wind and rain. They die a natural death by the filling up of the barometrical depression, but this sometimes does not take place until they have travelled more than half round the world. A short discussion ensued, in which the lecturer was asked to explain some points, and amongst them how it was that the readings of the barometer in South Australia did not show such extremes as in Great Britain for example. The reply was that the majority of storms which visited us had their centres well to the southward of the continent, so that Adelaide was brought only under the influence of the northern lip of the depression, where the readings of the barometer were not so depressed as nearer the storm centre.

Fifth Evening Meeting—Tuesday, July 28, 1885.

On this evening Mr. G. Beazley gave a second "Demonstration in Taxidermy." There was a fair attendance. Mr. Beazley read a paper dealing with the bony frame of birds, and explained how lightness and strength were combined in its con-

struction. The entire anatomy of the bird was described in detail, and articulated skeletons of various birds were shown in illustration of the subject. Mr. Beazley then proceeded to give a practical demonstration of the method of preparing and stuffing birds, also deer, lizard, and leopard, skins of which he exhibited. He showed a beautiful specimen of the large fish *Cossyphus Gouldii*, or blue groper, and explained the method of preparing it. A hearty vote of thanks was accorded the lecturer at the close of the meeting.

SIXTH EVENING MEETING—TUESDAY, AUGUST 18, 1885.

There was a moderate attendance. Professor Tate occupied the chair and directed attention to an exhibit of a mass of fossil oyster shells from the River Murray cliffs, and said the particular species was found in beds of three, four, and even twenty or thirty feet thick. It differed in certain particulars from the Port Lincoln oyster. He gave it the name of *O. Sturtiana*, in honour of Captain Sturt, who first recorded its occurrence at Overland Corner. The Professor also directed attention to a specimen of *Solen vaginoides*. It seemed almost confined to the north shores of Kangaroo Island, but had been found in the Port Creek, though not alive,

Professor Tate then read the following paper on

MOLLUSCAN LIFE IN ST. VINCENT GULF.

A. SURFACE LIFE.—The only species at all common is the squid *(Sepioteuthis Mauritiana)*; another cephalopod has occurred, it is *Spirula lævis*. The violet-tinted shells of *Ianthina exigua* and *I. violacea* have been taken; but on the open coastline the *Ianthinæ* and another species, *I. communis*, the delicate *Argonauta*, and a few *Pteropods* are sometimes cast up in great numbers. The majority are swimmers; the *Ianthinæ* are sustained by floats.

B. BOTTOM LIFE.—The action of the waves below the surface decreases as the depth increases, ceasing at a few fathoms. Below this surface-disturbance no movement occurs except that caused by the quiet flow of ocean currents. The molluscs exposed to the action of the waves exhibit a rich variety of adaptation of structure to the various conditions under which they live. These variations are chiefly in respect of the powers of attachment or locomotion, according as to whether the habitat is unstable or not under the attacks of waves and currents. The mollusca, in respect to habitat, or the kind of bottom on which they reside, may be considered under the following heads:—(1) Those which live between tide-marks in bays and

estuaries sheltered from wave disturbances; (2) those which live on the seashore exposed to wave and tidal action; (3) those living at the sea-bottom outside the tidal strand. The species are not only restricted in their range in depth, but also in respect to habitat in accordance with their structure.

Littoral Life.—1. Mollusca living between tide-marks in sheltered bays and estuaries.—Exemplar stations are the Port Creek and the estuary of the Onkaparinga. The tidal strand is here usually composed of mud often clothed with a green mantle of Zostera; whilst pools at the upper limit of the tide furnish a vegetable growth of *Lepilæna Preissii*, amongst which live *Pomatiopsis striatula*, *Tatea rufilabris*, *Bithynella Victoriæ;* whilst at the extreme upper limits of ordinary tides, sheltering under *Salicornia*, *Suæda*, *&c.*, the pulmonates *Ampullarina Quoyana*, *A. fragilis*, *Alexia meridionalis* and *Pythina ciliata*; and *Risella melanostoma*, *Assiminea sp.* Between tidal-marks the majority of the gastropods are vegetable feeders—*Bittium granarium*, *B. Lawleyanum*, *B. turritum*, *Risella melanostoma*, *Trochochocolea tæniata*, *Acmæa conoidea.* The only common carnivorous gastropod is *Tropon australis.* Here is the chief habitat of the bivalves *Tellina deltoidalis*, *Anapa cuneata*, *Chione aphrodina* and *Modiola flavida*—the three former burrowing by means of their foot, the last forming a nest for itself in the soft mud.

2. Mollusca living on the tidal strand of the exposed coast.—These may be considered under two heads, viz., *(a)* Those living on rock or other firm foundation, and *(b)* those living in sand or mud.

(a) Those living on rocks. The methods by which they resist the attacks of waves are various, some of which are well known. Examples of permanent attachment are the oyster and mussel, of temporary attachment, the limpet and chiton, and of boring, the pholas. In addition, there is a large number deficient in powers of attachment, which find protection from the waves by secreting themselves under large flat stones or in rocky crevices. Living on rock, as it were between air and water, and where moistened only by the spray of the breakers, occur the pulmonate snails *Marinula patula* and *Truncatella scalarina*, and the branchiferous snail *Littorina Mauritiana;* whilst the minute bivalve *Lasea rubra* nestles in crannies of the rock-face. The gastropods living on rocks exposed to breakers have almost without exception shells of an ovate or rounded outline, shortly conical or more or less flattened—shapes best adapted to resist the action of the waves. A list of the commoner species was given. The carnivorous species are few, the commonest ones are—*Trophon Flindersi*, *Pupura succincta*, *Ricinula Adelaidensis*, *Cominella costata*, and *C. alveolata.* All

of these have considerable powers of attachment by the aid of their broad locomotive discs; their shells are excessively thick, and though not so rounded in outline as the majority of the littoral snails, yet they are not strictly elongate. An aberrant snail *(Cladopoda arenaria)* inhabits an irregularly convolute tube agglutinated by the lower half to rock surfaces. The bivalves are very few in number, and the only commonly occurring ones are *Mytilus rostratus*, *M. Menkeanus*, *Modiola australis*, which are anchored in patches or clusters by their byssal threads; amidst the mussels the little *Lasæa rubra* finds a safe dwelling. The rock oyster *(O. glomerata)* is occasionally found here, out of its usual station below low-tide mark. On flat rocky shores, as off Snapper Point, Aldinga Bay, and about Stansbury and other places on the west side of the Gulf, the cavernous depressions of the surface, and the shelter afforded by the large flattened stones, are the lurking places of many gastropods, whose shape of shell and formation of foot ill adapt them to live in exposed situations.

(b) Those living in sand. This habitat is unstable under the attacks of the waves, and no powers of attachment will serve the animal; safety lies in the quickness with which it can penetrate the sand either to avoid being washed away in the denudation of the deposit, or to force its way to the surface through any accumulation that may he piled over it. The only gastropod which habitually lives in this habitat is *Natica conica*, whose shell is smooth and subconic, not well adapted for burrowing, but offers a passive resistance to wave currents. On the ocean seaboard, where tidal disturbances are so much greater, there lives anothes species (*N. Incei*), which has a hemispheric shell. The bivalves, which inhabit this kind of deposit, have compressed valves and hatchet-like or cylindrical forms well suited for rapid penetration; whereas the globular form of shell, which is ill-adapted to force its way through a resisting medium, is unrepresented on our sandy tidal region. One of the most active in penetrating sand in which it lives is *Solen vaginoides*, having a narrow cylindrical form. All the bivalves live in long burrows, and have long siphons, which must be valuable in self-defence, more especiallv in the case of their young, which, from their small size, would be affected by much slighter wave disturbances than the adults, and would be in constant danger if obliged to live at the surface or close to the surface of the deposit that gave them shelter.

The little *Mesodesma elongata* resides at little depth below the surface, and nearer high-water mark than any other of the burrowing species, and is therefore particularly liable to be exposed, as is fully attested by the vast numbers displaced during gales. It burrows, however, very readily, and moves on

the surface of the sand with much expedition. Our two species of Pholads (*Barnea similis* and *B. australasiæ*) and *Venerupis obesa* burrow in stiff clay at low-water mark.

Molluscs living beyond low-tide.—Those living on rocky bottoms present no special feature from those living between tide-marks, except that a greater number of species occur, increasing somewhat with the depth. The greatest variety of life occurs undoubtedly on rocky bottoms extending to a few fathoms in depth. Here haunt a large species of *Octopus*—*Cypræa thersites*, the *Volutes*, *Ostrea Angasi*, *Pecten laticostatus*. The delicate parchment-like shell of *Avicula pulchella* anchors to the stems of seaweeds, and the delicate limpet, *Nacella parva*, creeps upon them; *Waldheimia australis* also in the same position, and fixed to other submarine bodies. *Gastrochæna Tasmanica* lives in crypts which it excavates in limestone or in the thick test of oysters.

Molluscs living on soft bottom beyond tidemarks.—In shallow water ranging to six fathoms life is very abundant, especially among the submarine pastures of *Cymodocea zosterifolia* and *Posidonia australis*, which afford secure protection against ordinary wave currents, and are the favourite haunts of the Sepias and Sepiolas among cuttlefish. Globose bivalves and slender turrited shells here only are found. It is unnecessary to enumerate the species inhabiting this region, but I may indicate some of the novelties in respect to habit. *Pinna Zealandica* lives in large colonies anchored vertically in the mud by means of its sharp apex and long byssal threads; parasitic on it are *Crepidula immersa*, *Amalthea conica*, *Placunanomia Ione*, *Hipponyx*. The delicate *Anatinas* form deep burrows; *Vulsella ovata*, *Modiolaria Cumingiana*, *Siliquaria australis*, and *S. Tahitiensis* burrow in sponges; whilst *Pecten asperrimus* is conversely the host of a soft red sponge: a species of *Eulima* lives on *Cidaris* and other echinoderms.

The waters of St. Vincent Gulf are for the most part very shallow, and little or no exploration has been carried beyond a few fathoms, except in one instance only, to my knowledge, in Backstairs Passage, whence was obtained a few mollusca, from 32 fathoms, which have not been met with elsewhere in the Gulf, and some not at all. They are *Erato lachryma*; *Cardita sp.*; *Gastrochæna lamellosa*; *Limea*, *n sp.*; *Terebratulina cancellata*.

In adding a few remarks on the subject of his paper, the Professor pointed out that if the Port Creek and Largs Bay were each to be fossilized, it would be found that the common shells of the one were not the same as the common shells of the other. He did not agree with the attempts that had been made to place the various fossil localities in the Older Tertiaries

of South Australia in superposition. Dissimilarity of life did not always indicate difference of age. Some cases of fine specimens were exhibited and examined.

Mr. A. Molineux then read an interesting paper on "Methods of Exploring the Sea Bottom," in which he described various appliances used in trawling and dredging, and referred to an element of danger in the pursuit, viz., stings from various fish that are armed with poisonous barbs and spines, *e.g.*, catfish, perch, gurnet, and particularly the "cobbler" (*Apistes marmoratus*), stated that he had tried grappling-irons for the deeper waters of the passage between Cape Jervis and Kangaroo Island without encouraging success, and concluded by pointing out that when dredging and trawling are conducted for scientific purposes a great many particulars were recorded, viz., latitude and longitude; depth, temperature, and density of water; direction and force of wind; the tides; the number, species, varieties, character, &c., of specimens obtained; the time of year, and many other things.

After an expression of opinion on the desirability of further dredging operations in the Gulf the meeting closed.

Seventh Evening Meeting—Tuesday, September 15, 1885.

Professor Tate occupied the chair. There was a good attendance. One new member was elected. A number of specimens obtained on the trawling expedition of the previous evening, consisting of sponges, crustaceans, fishes, ascidianes, molluscs, and other denizens of the Gulf, were exhibited, and the President made explanatory remarks. A specimen of a rare snake—the *Hoplocephalus spectabilis* of Krefft—found at Scott's Creek, near Nairne, was exhibited by Professor Tate. The reptile was alive, and of a poisonous species, but Professor Tate stated that it was very small, and practically harmless. It was very little known. A specimen was obtained some twenty years ago in the Port Lincoln district by Mr. Masters, and he (the speaker) had found one since at Ardrossan. Mr. J. G. O. Tepper, F.L.S., showed some orchids from Kangaroo Island, comprising *Caladenia lolifolia*, *C. clavigera*, *C. filamentusa*, *Diuris longifolia*, *Liperanthus nigricanes*, *Prasophyllum* (sp. large-flowered), *Caladenia* (with very small flowers, perhaps new), and *Pterostylis* sp. The President announced that owing to the continued illness of Dr. Stirling, his lecture, "The Borderland of the Animal and Vegetable Kingdoms," was postponed. Mr. Molineux described in a conversational way some of the marine curiosities secured at a trawling expedition on the previous evening. A so-called native hare

(Peragalea lagotis), with a young one in the pouch, was shown by Mr. Beazley; it came from Orroroo.

ANNUAL MEETING—TUESDAY, OCTOBER 13, 1885.

There was a fair attendance. Four new members were elected. Along one side of the room was arranged a fine collection of New Zealand ferns by Mr. J. G. O. Tepper, F.L.S. There were exhibited on the table a number of specimens obtained on trawling expeditions, and they were briefly noticed by Prof. Tate, who named a cuttlefish as *Sepia brevimanus*, so called from the short arms. The largest size he had met with was thirteen inches. A great novelty presented was the young of the Echidna. The Professor also described a tray of interesting shells; also some orchids (submitted by Mr. Tepper) which were not of any recorded species.

Professor Tate said the work of the past year had not been of such an encouraging kind as could have been desired. They had had a good deal of lecturing during the winter evenings, but the Society had not progressed. That might arise from the novelty wearing off, but those that remained were the ardent students. In comparing the work done by this Section with that done by a similar Society in Melbourne, he might say that the field excursions here were better attended than those of the Melbourne Field Club, but on the other hand the night-work over there was far in advance of ours. There was always a long list of exhibits drawn from all parts of the world, and generally an indication of better work by the students. The excursions here had been comparatively well attended, but the evening meetings poorly so. Perhaps the members had lost sight of the real object of the evening meetings, which was to supplement the knowledge gained at the excursions. Although he ceased to be Chairman he would ever be ready to show as active an interest in the Society as heretofore. The Secretary then read the following:—

ANNUAL REPORT OF THE COMMITTEE.

"In submitting the second annual report of the Section the Committee are pleased to be able to regard the year's proceedings as on the whole of a satisfactory and encouraging nature.

"The novelty attaching to the inauguration of the Section (it being an entirely new feature for the colony) has now had time to wear off, and, although the large gatherings at the first few meetings have not since been equalled, the attendances this year, especially at the whole-day excursions, have been well sustained.

"Five whole-day and ten half-day excursions were arranged for during the year, a new departure having been instituted in fixing outdoor meetings in the winter as well as summer months. Owing to the unfavourable state of the weather, however, on the days fixed for Saturday afternoon excursions in the months of May, June, July, and August those meetings virtually fell through, proposed visits to the Botanical and Zoological Gardens being amongst the number.

"Seven evening meetings have been held most of iwhich were fairly attended. On two of these occasions demonstrations in taxidermy were given by Mr. G. Beazley with the kind permission of the Museum authorities.

"In the month of May, 1885, the Committee received with great regret the resignation of the Honorary Secretary of the Section, Mr. W. E. Pickels, F.R.M.S., on account of his removal to another colony. The Committee desire to express their sense of the loss sustained by the Section in consequence of this step, and their appreciation of the energy and ability with which Mr. Pickels conducted its affairs.

"A by-law has been passed by the Section requiring Fellows of the Royal Society to pay a registration fee of one shilling each if desirous of becoming members of the Section. This action has been confirmed by the Royal Society.

"Thirty members have been added to the Section during the year, but about fifty names have been removed from the roll, either on account of resignations, non-payment of subscriptions, or for other reasons. The present number of members is therefore less than at the close of last year. It is evident that very many of those whose names appeared on the roll have taken but little interest in the active work of the Section, not a few having never attended any of its meetings, and others but very seldom.

"During the year the Council of the Royal Society conferred on the Section the honour of inviting the members of the latter to be present at the meetings of the Royal Society.

"The expenses of the Section have been, as in the previous year, much greater than the receipts from subscriptions, the latter amounting to about £20, while the disbursements (chiefly for printing and postage), have been about £40. It is intended, however, to adopt a system in the coming year by which it is hoped the Section will become self-supporting.

"For the Committee,

"W. H. Selway, Jun., Hon. Sec."

Professor Tate, in reference to the report, said the expense were about double the amount of the receipts. He hoped to see a balance on the right side next year, so that there might be a surplus to set apart for awarding prizes. He would

supplement the sum to a reasonable amount. He moved the adoption of the report, which was carried.

The election of officers then took place, as follows:—Chairman, Dr. Cleland; Vice-Chairmen, Mr. J. G. O. Tepper and Dr. Magarey; Hon. Secretary, Mr. W. H. Selway, jun.; Committee, Professor Tate, Messrs. Molineux, G. G. Mayo, G. Collis, H. Dean, D. J. Adcock, D. Fleming, W. J. Sowden.

After some scientific discussion and a paper read by Mr. Tepper upon the "Geological Features of Stonyfell"—

Professor Tate stated that a testimonial had been purchased by the members of the Society for the late Secretary, Mr. Pickels.

The testimonial, a handsome gold chain and locket, the latter suitably inscribed, was handed over to Mr. G. Collis, who responded for Mr. Pickels, and undertook to forward it to that gentleman.

OFFICERS.

CHAIRMAN:

Mr. W. L. Cleland, M.B.

VICE-CHAIRMEN:

Mr. J. G. O. Tepper, F.L.S.
Mr. S. J. Magarey, M.B.

COMMITTEE:

Professor Tate, F.L.S., F.G.S.
Mr. A. Molineux.
Mr. G. Collis, jun.
Mr. H. Dean.
Mr. D. J. Adcock.
Mr. G. G. Mayo.
Mr. W. J. Sowden.
Mr. D. Fleming.

HON. SECRETARY:

Mr. W. H. Selway, jun.

FIELD NATURALISTS' SECTION OF THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

BALANCE-SHEET, 1st OCTOBER, 1885.

1884.	Dr.	£	s.	d.
Oct. 22.	Balance in hand	5	12	0
1885.				
May 17.	Grant from Royal Society of South Australia..	20	0	0
Sept. 24.	" " " ..	35	0	0
		£60	12	0

1884.	Cr.	£	s.	d.
Nov. 2.	Secretary, W. E. P., Cash	1	0	0
Dec. 1.	" " "	1	0	0
Jan. 10.	" " "	1	0	0
Jan. 24.	" " "	0	10	0
Feb. 18.	" " "	1	0	0
Mar. 10.	" " Postages	8	0	0
Mar. 15.	" " Cash	1	10	0
Mar. 19.	Sherring & Co., Printing	15	1	6
June 30.	Geo. Beazley, Expenses	1	8	9
Sept. 24.	Sherring & Co., Printing	22	16	0
Sept. 30.	Handed to Treasurer Royal Society ..	7	5	9
		£60	12	0

W. H. SELWAY, Jun., Hon. Sec.

Audited and found correct,

WALTER RUTT,
LIONEL C. E. GEE } Auditors.

Adelaide, 30th September 1885.

LIST OF MEMBERS

OF

FIELD NATURALISTS' SECTION

OF THE

ROYAL SOCIETY OF SOUTH AUSTRALIA

AT DATE OF ANNUAL MEETING, OCTOBER 13, 1885.

Those marked † are Fellows of the Royal Society, S.A.
Those before which the letter F appears are foundation members.

†FAdamson, Mr. D. B., Angas-street, Adelaide.
FAdcock, Mr. D. J., Currie-street, Adelaide.
Addison, Mr. H. M., King William-street, Adelaide.
FAitken, Mr. J., Parkside.
Anderson, Mr. T. G., N.E.-road, Medindie.
FBaker, Mr. W. H., 34, King-William-street.
Beazley, Mr. Geo., The Museum, Adelaide.
†Beresford, Mr. D. J. D., Parliament House, Adelaide.
Best, Mr. D. (Hon. Memb.), 16, Little Collins-street E., Melbourne.
Bevilaqua, Mr. L. W., Fullarton.
FBeythein, Mr. E., Moonta.
FBishop, Mr. J. F., Union Bank, Adelaide.
FBottomley, Mr. W. D., Savings Bank, Adelaide.
FBoulger, Professor, University, Adelaide.
Bowen, Mr. F. C., Freeman-street, Adelaide.
Brook, Mr. W. J., J.P., Pirie-street, Adelaide.
Bruce, Mr. J., Architect-in-Chief's Office, Adelaide.
†FBruer, Mr. J. J., King William-street, Adelaide.
†Bussell, Mr. J. W., F.R.M.S., Railway Station, Adelaide.
Chipp, Mr. H. E., Currie-street, Adelaide.
†FCleland, Dr. W. L., Parkside.
Cleland, Mrs. W. L., Parkside.
FCollis, Mr. G., jun., Gawler-place, Adelaide.
Coppen, Mr. E., c/o Mrs. Symes, Grenfell-street, Adelaide.
Cornock, Mr. T., The Museum, Adelaide.
FDane, Mr. F. N., Eliza-street, Waymouth-street, Adelaide.
†FDavies, Mr. E., Flinders-street, Adelaide.
FDean, Mr. H., jun., Carrington-street, Adelaide.
Dixon, Mr. S., c/o Messrs. Luxmoore & Co., Limited, Adelaide.
†FDobbie, Mr. A. W., Gawler-place, Adelaide.
Dombrain, Mr. H. A. A., c/o Messrs. Young & Smith, Waymouth-street, Adelaide.
†FEvans, Mr. T., King William-street, Adelaide.
FFabian, Mr. T., City Treasurer, Adelaide.
FFarrar, Mr. G. E., C.E., Clare.
FFleming, Mr. D., Mackinnon-parade, North Adelaide.
†FFletcher, Rev. W. R., M.A., North terrace, Kent Town.
Fornachon, Mr. C. L. F., Y.M.C.A., Adelaide.

rFrayne, Mr. N., c/o Messrs, D. & W. Murray, Adelaide.
rFrench, Rev. S., M.A., Glenelg.
rFuller, Mr. W., University, Adelaide.
†Gall, Mr. D., Tynte-street, North Adelaide.
Gallagher, Mr. W. E., Port Germein.
Gee, Mr. L. C. E., c/o Surveyor-General's Department, Adelaide.
Grasby, Mr. W. C., Salisbury.
Guest, Mr. E. (Hon. Memb.), Balhannah.
Gurner, Mr. J. R., North-terrace, Adelaide.
Hammond, Mr. H., Childers-street, North Adelaide.
rHampson, H., Leigh-street, Adelaide.
rHaslam, Mr. J., C.E., Pirie-street, Adelaide.
Hill, Mr. C., Alix House, South-terrace, Adelaide.
Hill, Mr. W. H., Quorn.
†rHowchin, Mr. W., F.G.S., Goodwood E.
Howell, Mr. F. J., H.M. Gaol, Adelaide.
Howell, Mr. Geo., Pirie-street, Adelaide.
rHunwick, Mr. Charles, Hindmarsh.
rHussey, Mr. G. F., G.P.O., Adelaide.
Jacobs, Mr. Geo. W., Currie-street, Adelaide.
Jameson, Mr. Geo. E., Union Bank, Adelaide.
Jobson, Mr. C., Hydraulic Engineer's Office, Adelaide.
Johnson, Mr. J. A., Franklin-street, Adelaide.
Johnson, Miss, "St. Catherine's," Prospect.
†Kelly, Rev. R., Mount Barker.
Kirby, Mr. E., Farina.
†Knight, Mr. G. C., Durstan House, North Adelaide.
Lawrance, Mr. V., J.P., Lefevre-terrace, North Adelaide.
Lawrance, Mr. C., Lefevre-terrace, North Adelaide.
Lawson, Mr. J. D., Divett-place, Adelaide.
rLeader, Mr. C. S., King William-street, Adelaide.
†Leary, Mr. J. L., M.A., South-terrace W., Adelaide.
Light, Mr. W., Wentworth, N.S.W.
Lindow, Mr., Messrs. J. S. Sanders & Co., Hindley-street, Adelaide.
rLock, Mr. E. H., *Register* Office, Adelaide.
†rMagarey, Dr. S. J., North-terrace, Adelaide.
Magarey, Mr. T. C., jun., Waymouth-street, Adelaide.
†rMayo, Mr. G. G., Pirie-street, Adelaide.
rMcEwin, Rev. J., *Colonist* Office, Currie-street, Adelaide.
†rMestayer, Mr. R. L., C.E., F.R.M.S., Hydraulic Engineer, Adelaide.
rMillar, Mr. A. P., Adelaide.
†rMohan, Mr. J. H., Crafers.
†rMolineux, Mr. A., Kent Town.
rMolineux, Mr. A. E., Kent Town.
†rMunton, Mr. H. St., North-terrace, Adelaide.
O'Connor, Mr. M. J., Public Library, Adelaide.
†Parker, Mr. T., C.E., St. Vincent's Chambers, Port Adelaide.
Phillips, Professor, M.A., University, Adelaide.
†rPickels, Mr. W. E., F.R.M.S., Melbourne.
Poole, Mr. W. B., Savings Bank, Adelaide.
†rPoulton, Dr. B., Adelaide Hospital, Adelaide.
Pullein, Mr. R. H., King William-street, Kent Town.
Read, Mr. Geo. A. G., Telegraph Office, Adelaide.
Robertson, Mr. J., Angas-street, Adelaide.
Robertson, Mr. W., North-terrace, Adelaide.
rRogers, Mr. A. L., 3, Rundle-street, Adelaide.
Rosenhain, Mr. O. W., Box 125, G.P.O., Adelaide.
rSansom, Mr. P., Currie-street, Adelaide.

FSelway, Mr. W. H., jun., The Treasury, Adelaide.
FShapter, Mr. W. T., Public School, Gumeracha.
†Smeaton, Mr. S., B.A., Bridgeport.
†Smyth, Mr. J. T., B.A., B.Sc., Model School, Norwood.
FSowden, Mr. W. J., *Register* Office, Adelaide.
†FStirling, Dr. E. C., M.A., Lefevre-terrace, North Adelaide.
†FTate, Professor, F.G.S., F.L.S., Buxton-street, North Adelaide.
FTate, Miss, Buxton-street, North Adelaide.
Taylor, Mr. G., South-terrace, Adelaide.
†FTepper, Mr. J. G. O., F.L.S., Somerset-place, Norwood.
Thwaites, Mr. F. J., National Bank, Adelaide.
†Todd, Mr. C., C.M.G., Postmaster-General, Adelaide.
†Varley, Mr. A. K., Kirtonville, Mount Gambier.
†Wainwright, Mr. E. H., Collegiate School of St. Peter, Hackney.
Walker, Mr. A., Y.M.C.A., Adelaide.
Watts, Mr. H. (Hon. Memb.), Wellington-street, Collingwood, Melbourne.
Webb, Mr. W. H., William-street, Norwood.
FWhatham, Mr. F. G., Freeman-street, Adelaide.
FWhitney, Mr. F. M., Messrs. J. Colton & Co., Adelaide.
†FWhittell, Dr. H. T., F.R.M.S., Astor House, New Glenelg.
Wilson, Mr. I., F.E.I.S., Goodwood.
Wilson, Mr. S. P., Uraidla.
Wiseman, Mr. A., Freeman-street, Adelaide.
Witherick, Mr. J., Waymouth-street, Adelaide.
†Woodward, Mr. H. P., F.G.S., Government Geologist's Office, Adelaide.
†Wragge, Mr. C., F.R.G.S., The Observatory, Torrens Bank, Walkerville.

Au. Cat. Ti. Cat.

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. IX.

(For 1885-6.)

LIBRARY OF
Illinois State
HISTORY OF NATURAL HISTORY,
URBANA, ILLINOIS.

ISSUED MARCH, 1887.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.
1887.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Webb, Vardon, & Pritchard, Printers, Gresham Street, Adelaide.

TRANSACTIONS AND PROCEEDINGS

AND

REPORT

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA.

VOL. IX.

(For 1885-6.)

ISSUED MARCH, 1887.

Adelaide:
G. ROBERTSON, 103, KING WILLIAM STREET.
1887.

Parcels for transmission to the Royal Society of South Australia, from Europe and America, should be addressed "per W. C. Rigby, care Messrs. Thos. Meadows & Co., 35, Milk Street, Cheapside, London."

Royal Society of South Australia.

Patron:
HER MAJESTY THE QUEEN.

Vice-Patron:
HIS EXCELLENCY SIR WILLIAM ROBINSON, K.C.M.G., C.B., &c.

OFFICERS.

[Elected October 5, 1886.]

President:
PROFESSOR RENNIE, D.Sc., F.C.S.

Vice-Presidents:
WALTER HOWCHIN, Esq., F.G.S. (Editor).
RICHARD L. MESTAYER, Esq., C.E.

Hon. Treasurer:
WALTER RUTT, Esq., C.E.

Hon. Secretary:
W. L. CLELAND, Esq., M.B.

Other Members of Council:
H. T. WHITTELL, Esq., M.D. (Re-presentative Governor)
C. TODD, Esq., C.M.G., M.A.
D. B. ADAMSON, Esq.
J. W. BUSSELL, Esq.
PROFESSOR BRAGG, B.A.
J. DAVIES THOMAS, Esq., M.D.

Assistant Secretary:
MR. A. MOLINEUX.

CONTENTS.

PAGE.

W. Ernest Cooke: A Few Notes on Jupiter (plate i.) 1

Prof. E. H. Rennie: Poisoning by Tinned Foods 10

J. G. O. Tepper: Notes on Some South Australian *Trogidæ* and a New Species of *Trox* 12

J. G. O. Tepper: Notes on *Ogyris Amaryllis*, Newm. 13

G. Goyder, Jun.: On the Production and Measurement of Gold and other Metallic Spheres to determine their Weight 15

R. B. Lucas: On the British Standards (plates vii.-xiii.) 18

Gavin Scoular: Sketch of the Geology of the Southern and Western Parts of the Lake Eyre Basin (plate iii.) 39

Baron F. von Mueller: Additions to the Extra-Tropical Flora of South Australia 57

Baron F. von Mueller: Description of a New Corchorus from Central Australia 58

Prof. R. Tate: Diagnosis of a New Species of Caladenia (plate ii.) .. 60

Prof. R. Tate: Description of some New Species of South Australian Marine and Fresh Water Mollusca (plates iv.-v.) 62

Prof. R. Tate: A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia 76

J. G. O. Tepper: Description of a Supposed New Species of Phasmidæ (plate vi.) 112

J. G. O. Tepper: Additions to the Flora of Kangaroo Island 114

John Brazier: Troghidæ and other Genera of South Australia, with their Synonyms, Part I. 116

E. Guest: A Classified List of Geometrina found round Balhannah, with Notes on Species 126

Prof. R. Tate: The Lamellibranchs of the Older Tertiary of Australia, Part II. (plates xiv.-xx.) 142

Prof. R. Tate: The Scaphopods of the Older Tertiary of Australia (plate xx.) 190

Prof. R. Tate: The Pteropods of the Older Tertiary of Australia (plate xx.) 194

Clement L. Wragge: Scientific Observations made during the Voyage of the Maranoa from London to Adelaide, 1883 (plates xxi.-xxvi.).. 201

MISCELLANEA.

Plants Collected in the vicinity of the Mulligan River by Mr. W. H. Cornish—Baron F. von Mueller 213

Additional Lichens and Fungi of South Australia—J. G. O. Tepper .. 215

Excerpts from Baron von Mueller's Third and Fourth "Supplements" 216

Additions to the Entomological Fauna of South Australia—E. Meyrick. 218

New Australian Freshwater Entomostraca 219

Remarks on an Unusual Development of a Low Vegetable Organism—W. Howchin 219

Abstract of Proceedings 221

Annual Report 225

President's Address 228

Balance-sheet 247

Donations to the Library 248

List of Fellows, Members, &c. 254

APPENDIX.

Proceedings of Field Naturalists' Section—

Excursions—Rocky Gully—Montacute—Waterfall Gully—Onkaparinga—Mount Lofty—Aldgate—Glen Stuart—Fletcher's Dock—Trawling in St. Vincent Gulf—Marino to Hallett's Cove—Patawalonga Creek—Glen Stuart—Government Farm—Golden Grove—Blackhill—Highbury and the Gorge 257-280

Evening Meetings—

Gossip Meetings 280-282

Lectures—Chairman's (Dr. Cleland) Address; J. G. O. Tepper, "Metamorphosis of Insects;" Walter Howchin, "The Preparation of Microzoa;" Dr. Stirling, "The Borderland of the Animal and Vegetable Kingdoms; W. T. Bednall, "Bivalve Shells" 283-290

Annual Meeting and President's (Dr. Cleland) Address .. 291

List of Members 298

Microscopical Section 301

A Few Notes on Jupiter.

By W. Ernest Cooke, B.A., Assistant Astronomer.

[Read February 2, 1886.]

Plate I.

The phenomena revealed in the Jovian system are as remarkable as they are obscure, and evidently denote the existence of forces in an intensity of manifestation utterly unknown in this world at the present time. The condition of Jupiter's surface is a subject for interesting speculation. We cannot possibly say with certainty what that condition may be, but have reasons for believing that some of the whiter portions, at all events, consist of a semi-transparent vaporous substance. Mr. Todd, our Government Astronomer, was the first to point out this peculiar semi-transparent property; for on one occasion, when watching an occultation disappearance, he distinctly saw the satellite *through* the planet's limb, and could still see it when its light must have pierced through more than a thousand miles of the surface matter of the planet. This was confirmed by subsequent observation and after the fact had been pointed out several other astronomers, including Mr. Ellery, of Melbourne, observed the same effect. I have witnessed this phenomenon on several occasions during the past two or three years, when the definition of the limb has been so remarkably sharp as to utterly preclude any idea of optical illusion. Ths whole of the planet's surface, however, is not white, but there are well-marked dark belts, which seem to keep their shape more or less the same for a number of years, and dark and bright spots that disappear and reappear in a remarkable manner, some apparently suddenly, but most, I think, gradually. The principal belts (all of which are almost parallel to the equator) are two dark ones about five to ten degrees on either side of the equator, and inclosing a broad equatorial light band, with many interesting markings. Besides these there are occasionally visible narrow belts in the northern and southern temperate and polar regions. The two principal ones seem to have kept their position ever since systematic observations have been taken, but they are noticed to be constantly changing in points of detail. The light equatorial band seems to be the centre of the most intense forces, for the markings here are constantly changing. I think it would be difficult in any series of sketches to find the same detail twice on this part of the planet. The *general* appearance remains fairly steady for some

length of time. During almost all of its last apparition the general appearance was that of a series of beautiful festoons, sometimes depending from the northern dark belt, but usually throwing out pillars to the southern and more conspicuous of the two. The interior of these festoons was generally beautifully white by contrast with the darker matter forming their substance, and sometimes, under not very favourable atmospheric conditions, would appear like brilliant white spots. I think it is quite possible that this has given rise to a degree of confusion with some astronomers in the northern hemisphere in respect to this part of Jupiter's surface, which will be referred to presently. Underneath a remarkable hollow in the south dark belt is the most striking feature on the whole planet —the great red spot. Spot is hardly an appropriate name for a space in which the whole of Australia would be lost, but it is the name that happens to be attached thereto. It is just possible that this spot was observed by Cassini in 1665 ; at all events, a famous spot was observed in that year by this illustrious astronomer. The next notice of it is in 1792, when Schroeter was observing an occultation of the planet by the moon on April 7. The most remarkable phenomena noticed were two nebulous undefined spots, perceptibly darker than the principal belt; and a still more remarkable spot is represented by Schroeter in the southern hemisphere of the planet, circular, bright in the centre, and with a dusky shading all round. A similar spot was also observed in 1786 and 1787. In 1868 Mr. Denning records on the south belt a dark spot of elliptical form. This may have been the precursor of the great southern ellipse first observed by Mr. Gledhill on November 14, 1869. This ellipse was situated in about the same latitude as the great red spot at present is, and is very likely the same object. In fact, a sketch made on January 23, 1870, reveals a most striking similarity to the present appearance of the planet in almost every respect. The first certain record we have of the appearance of the great red spot is from some observations made at the Morrison Observatory by Professor C. W. Pritchett in July, 1878. He says:—"On July 9 Jupiter was again examined from 11h. to 12h. 5m., Gl. M. T. I was surprised at the extraordinary changes which had occurred both in the spots themselves and in the contiguous parts of the belts. Two spots still showed, but much enlarged, and with irregular outlines. Their position, however, was very different from the position noted on July 6. The place of one was a little west of the most easterly one seen on July 6, and near the inner edge of the northern equatorial belt; but the other had changed to the south side of the southern equatorial belt, and far eastward, and seemed to be rapidly breaking up. What was more remarkable

was a total change of the whole structure of the belts in that vicinity and the formation of an elliptic cloud-like mass, separate from the general contour of the belts. This cloud was almost a perfect oval in shape, and was pre-eminently rose-tinted. But the most remarkable phase of all was the *rapid proper motion* of this 'elliptical cloud.' I watched it for nearly an hour, and in that time its front moved on the disc of the planet about one-fourth of the planet's diameter. It passed by the most easterly of the spots, and its front had reached to the most westerly spot, and was passing it at 12h. 5m., Gl.M.T." These remarks of Professor Pritchett were not written until November, 1878, and meanwhile other observers had noticed this spot. Mr. F. C. Dennett first saw it on July 27, and makes the following remarks *re* its proper motion:—"Between July 27, 13, and November 11, 5.5, the longitude of its preceding extremity seems to have increased some 24°, which means a proper motion eastward of more than 230 miles per day. But that is not all. At 6h. 5m., October 25, the oval patch was well elevated in the south temperate zone, whilst on November 11, 5.5, it had seemingly 'pushed' the equatorial belt some 8,000 miles nearer the equator." The next that seems to have been heard about this spot was from a letter written to the "Observatory" of April 1, 1879, by Mr. E. Leopold Trouvelot, of Cambridge, U.S.A., dated January 20, 1879. He observed it for the first time on September 25, 1878, at 6.30, C.M.T., and in his letter draws attention to the fact that it is apparently periodic in its visibility. He thinks, however, that this may not have been the identical spot seen on July 9 by Professor Pritchett, although it occupied almost exactly the same position; for Professor Pritchett failed to see it on July 10 and 15, when it should have been visible if it existed; and Mr. Trouvelot also failed to see the spot on September 6, 10, 15, 20, and 22, when Jupiter presented the same region to the observer. (We must not forget, though, that Mr. Dennett observed the spot on July 27.) Mr. Trouvelot further says:—"Between September 19 and 20 considerable changes occurred in the markings of the planet, the southern border of the equatorial belt assuming at one point a very characteristic angular form, which on the 25th was recognised on the west of the red spot, and quite close to it. If the red spot had existed on the 20th it is impossible that it should have escaped notice, as the atmospheric condition was very fine on that night, and a good drawing of Jupiter was obtained. It seems certain, therefore, that this spot formed between the 22nd and 25th of September, as it was not seen on the 22nd at 7h., C.M.T. It is very remarkable that this spot appeared precisely at the same place, or, at least, very nearly so, where a similar

object had been observed over two months before. The recurrence of some of the markings on Jupiter at the same places where similar forms had already been observed previously, although quite a rare phenomenon, is not, however, without precedent, as appears from my observations of this planet. For instance, the angular marking on the southern border of the equatorial belt described above, and near which the red spot made its appearance, very strikingly illustrates the principle of recurrences, since this spot, so familiar to me, has disappeared and reappeared three times in a period of observation embracing a little over one year." There seems to be something curious about this remark, for this particular marking is now visible, and has been ever since the appearance of the red spot. It is true that the angularity is now on the eastern side of the red spot, but this is attributable to a very gradual change, occurring as described below, and is due neither to a motion westwards of the red spot, nor to a sudden alteration of the belt. A similar angularity was noticed on the eastern side of the spot shortly after Mr. Trouvelot made his remarks, and it looked then as if the great red spot was simply an oval patch of the southern dark belt that had got separated and moved southwards, a huge bight being formed in the belt immediately north of the spot, of which the two angular formations previously noticed formed the edges. After a time a white streak was noticed almost all along the middle of the southern dark belt, and this gradually spread over that portion of the belt immediately west of the spot, until now the dark belt at this part of the planet is reduced almost to two streaks, the northern (corresponding to the north edge of the remainder of the belt) being very dark, and the southern so faint as to be almost invisible unless the definition is good.

Then, with regard to the periods of visibility of the red spot. In August, 1879, Professor Pritchett, in referring to Mr. Trouvelot's remarks, gives several dates on which the red spot ought to have been seen if it were visible, but mentions that, although he looked carefully for it, he was unable to see a sign of it. These dates are 1878, July 10, August 15, 31, September 10, 20, 22, October 2, and November 2. Added to these we have the days when Mr. Trouvelot looked for and failed to see it, viz., September 6, 10, 15, 20, 22. But, on the other hand, Mr. Dennett observed it on July 27, and at the Adelaide Observatory it was first noticed on August 4, and was again seen on the 9th and 13th of the same month. Professor Pritchett goes on to say:—"I find by numerous trials that this spot is plainly visible in my telescope with a power of 275 for more than two hours before and after passing the middle point of its visible arc of rotation. Here, then, are at least eight

different occasions on which I have observed Jupiter *closely* when this spot *should have been seen.* In several of them it should have been near the *middle of the disc.* Even considering its longitude 240 deg. (as Mr. Dennett has done), it could not *possibly* have passed out of sight by axial rotation. I cannot think it could be *present* and escape my attention, unless its character had *wholly changed;* for anyone who sees it *now* and *as it was* on July 9, 1878, a year ago, will at once detect it on any part of the disc. For instance, on the morning of July 2, 1879, as soon as my eye glanced on the disc I recognised it, though seen very *obliquely* to the line of sight and seen *unexpectedly* after the lapse of a year. Now, whether this spot has periods of 'recurrence,' as Mr. Trouvelot suggests, or whether at certain times it has a very rapid proper motion on the surface of the planet I cannot pretend to determine. On July 9 of last year I saw it extend beyond a white spot north of it, but *which was in motion* is unknown. . . . It is important, I think, to remember that both *preceding* and following the observation of July 9 the belt region was in a state of unusual agitation." I think that, taking into consideration Mr. Dennett's observation of July 27 and our own on August 4, 9, and 13, we may safely assert that the red spot was *visible* from July 9 (the first record we have of its appearance), until August 13. Then the question naturally arises, "Did this spot suddenly disappear between August 13 and 15, on which latter date Professor Pritchett failed to see it, although it should have been plainly visible?" If so, it is a most extraordinary occurrence, especially considering its enormous size. Then, as to the other hypothesis, "Could it have had an enormous proper motion at that time?" Of course it must be borne in mind that at present it is impossible to ascribe a proper motion to any spot on Jupiter, for astronomers have not yet satisfactorily settled which particular spots belong to the planet itself, and which are moving on its surface, and hence are unable to fix a period of revolution. But still it may be interesting here just to compare two notes, one by Professor Pritchett, already quoted, where he remarks on the motion of the red spot past two white spots in its vicinity, and the other made by Mr. Todd on the night of August 13, 10h.:—"The oval red space on the southern bright belt, noted on the 4th, still visible, but not the bright spot on the equatorial cloud belt, but a bright spot very like it precedes it several Jovian hours—being near the western edge of the planet, when the red space was rather more than half visible on the opposite or eastern side of the planet."

At present the red spot looks very similar to what it did in 1878 and 1879, although not quite so dark. Its immediate surroundings, however, have altered to a certain extent. If

we were to compare the drawing of Jupiter made on July 9, 1878, by Professor Pritchett with one made by ourselves at the present time, it would be difficult to imagine that it was one and the same object. But I cannot help thinking that the drawing published in the *Observatory* scarcely does justice to the subject. The drawing shows scarcely any sign of Jupiter's two well-known dark belts on either side of the equator, although Professor Pritchett makes constant reference to them. However, from our own remarks made about July, 1878, it is evident that there has been no enormous change in Jupiter's physical appearance. The most noteworthy alterations in the immediate neighbourhood of the red spot have been, first, the formation of that angularity in the southern dark belt immediately west of the spot, then the formation of an indentation in the south edge of the belt, and lastly, the evident superposition of that white cloud streak along the portion of the belt west of the spot, which has gradually widened until the belt is now reduced to a mere streak. In 1883 and 1884, however, the red spot became very faint indeed, and when the definition was unsteady could not be seen at all, even when at mid-transit. During periods of good definition we could just faintly glimpse it, but on most occasions we could only see its northern edge, which merged into a faint coloured streak a little south of the dark belt. The Director of the Dearborn Observatory (Mr. G. W. Hough) seems to have observed this spot all through 1883 and 1884. In his annual report for 1884 he says:—"It was seen on various occasions, with the Chicago telescope, entirely separate and distinct from any belt, and presenting the same outline that it did in 1879. The most marked change has been in its visibility. During the latter portion of the previous opposition it became very faint, and was announced to have disappeared, but observations were made on it at the Dearborn Observatory as long as the planet was visible."

The period of Jupiter's rotation has for a long time been, and is now, a *quæstio vexata* among astronomers. As early as Cassini's time the period was fixed at 9h. 55m. 30s., and ever since then various observers have deduced periods ranging from 9h. 55m. to 9h. 56m. Most of these have been obtained from well-defined *dark* markings, situated on or to the polar side of the two principal dark belts.

In 1871, however, Dr. Lohse took some observations of a bright spot near Jupiter's equator, and found the period of rotation of this spot to be less than 9h. 52m. In the "Ephemeris for the Physical Observations of Jupiter," Mr. Marth has until quite recently adopted 9h. 55m. 4s.; but in the Supplement to the monthly notices of the "R.A.S.," vol.

44, he has changed his period to 9h. 50m. 20s., this being the rate of rotation of a certain white spot in the equatorial regions. This seems to be a great mistake, for if it has always been the same white spot observed, it is far more reasonable to suppose that this spot has an enormous proper motion (something like 2,000 miles per day) westward, than to imagine that this spot has remained in the same place while all the other markings have been moving simultaneously eastward at this pace. The Director of the Dearborn Observatory seems to have devoted a considerable amount of attention to the rotation period of the red spot, and he obtains a mean for 1883-4 of 9h. 55m. 38·5s., or a mean for five years (1879-84) of 9h. 55m. 37·01s. There is one great disadvantage in taking "white spots," viz., that on the equatorial belt there are such a number of them, often coming and going on the same evening with the variability of definition. But the red spot cannot be mistaken, and it has always kept its position immediately south of the great hollow in the southern dark belt. Last year there were three beautiful little dark spots on the south edge of the southern dark belt, and these kept their positions relative to the red spot approximately ever since they were first observed here on February 19, 1885. They were situated a little east of the red spot, and could all be seen on the planet at the same time. The most eastern was just like the shadow of one of the satellites, quite black and round; the centre one not nearly so dark as either of the others, and elongated; the most westerly was of an elongated oval shape, and of a very dark red colour. No very accurate measures were taken, but a sufficient number of sketches were made to give a tolerably exact period of revolution, and the central spot gives for 77 revolutions 9h. 56m. 7s. In a similar manner the red spot from 70 revolutions gives 9h. 55m. 34s. On March 18, 1885, we discovered a round dusky spot on the equatorial light belt, just below the northern dark belt; this passed the central meridian at 11.41 a.m. It was observed on several occasions since, and again, after twelve Jovian days, passed the central meridian on March 23 at 9.47 a.m. This gives a rotation period of 9h. 50m. 30s., almost identical with that adopted by Mr. Marth in his "Ephemeris." I think there can be no doubt, however, that this is not a fair rotation period to assume, for by far the majority of the markings rotate in periods varying from 9h. 55m. to 9h. 56m., keeping their positions relative to one another at all events approximately. It is certainly curious that the white spot of Mr. Marth and our own little dusky spot should give so nearly equal a result, but from an inspection of our sketches it is easily seen that the dusky spot has a large proper motion westward relative to its environment.

There is, for instance, a well-defined break or hollow in the northern dark belt, which at first preceded the spot by some 20m., but which, on the 23rd, was considerably to the east of the spot. It is a noticeable fact that both the white spots and this dusky spot are on the light equatorial belt, and there are also one or two fainter markings on this belt that seem to keep their position relative to the dusky spot. It thus appears that the surface on the equatorial bright belt moves round faster, at the rate of about 2,000 miles per Jovian day, than the portions connected with the darker belts to the north and south of the equator. This extremely interesting hypothesis has been often previously stated.

It will be well in conclusion to take a rapid glance at the general physical appearance of Jupiter's surface at the present time. All round the north pole, extending to about latitude 45°, is a dark grey shading, which seems to defy the resolving power of even the largest and best telescopes. At times, with an unusually good definition, it presents a streaky appearance, and seems to consist of innumerable very fine lines parallel to the equator. South of the shading to about latitude 10° to 15° N. the planet's surface is of a white or very faint yellowish colour, broken by two dark bands encircling the planet in about latitude 23° and 25°. At 10° or 15° N. is the northern edge of the north dark belt. This is by far the most irregular belt or band on the planet. It is roughly parallel to the equator—as, in fact, are all the belts—but on either edge are protuberances, hollows, knots, breaks, &c., while the interior is constantly exhibiting white patches or streaks, looking like masses of white cloud. The northern edge is usually well defined, but the southern gradually merges into the equatorial bright belt. This belt is, perhaps, the most beautiful portion of the planet. Its general appearance, without critical examination, is that of a light reddish band round the centre of the planet, darker on the north than on the south side, and with a number of white-looking patches, somewhat like a bank of cumulus cloud resting on the dark belt bounding its southern extremity. On more careful examination it will be noticed that there are a series of festoons, some regular, but for the most part of a somewhat irregular formation, the tops of the arches making a wavy line along the equator; while the pillars of the festoons extend downwards to the south dark belt, which very often forms a protuberance to meet them. It is very likely, I think, that the white patches inside of these festoons, which are constantly changing, have given rise to the irregular rotation periods that have been quite recently deduced for Jupiter's equatorial regions; and the most interesting questions for the present Jovian season will centre in the

PLATE I.

FIG 3.

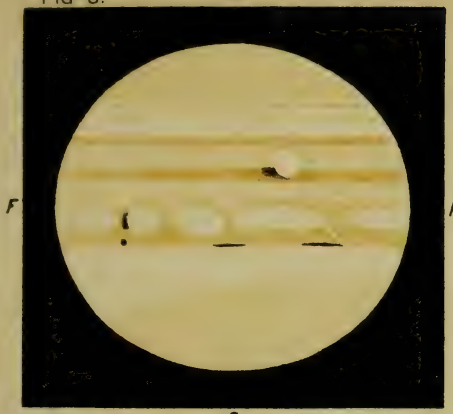


FIG 2.

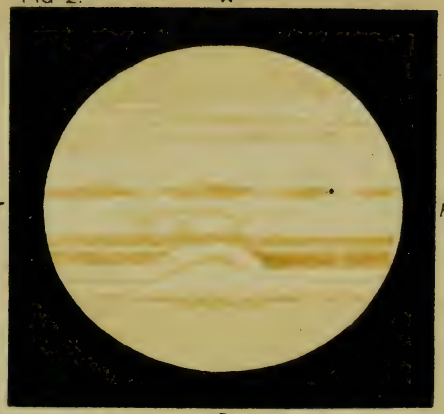


FIG 1.

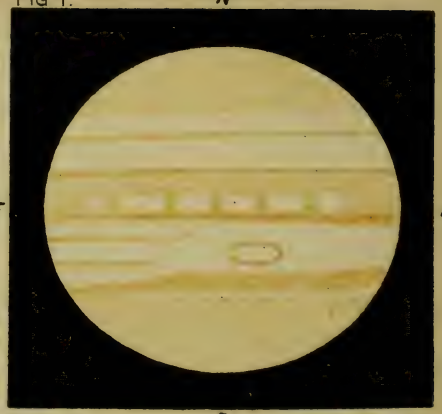


FIG 6.

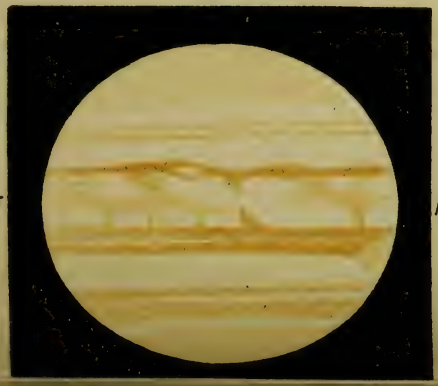


FIG 5.

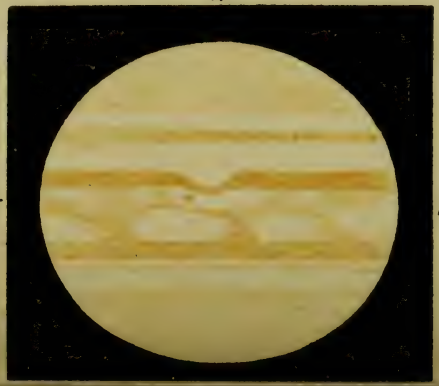
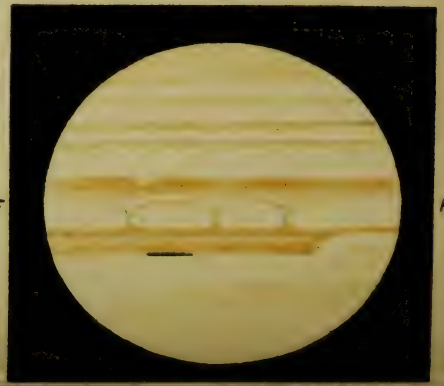


FIG 4.



E.M. MARRAL DEL.

permanence of any particularly white spot or patch, and its movement, if any, relative to the great red spot.

Explanation of Plate I.

Fig. I. represents Jupiter's surface on 1870, Jan. 23, 8.20 G.M.T. This is copied from a sketch made by Mr. Joseph Gledhill, and published in Vol. III. of "The Observatory."

Fig. II. represents Jupiter's surface on 1884, April 21, 5.51 A.M.T. The definition was excellent. The portion of the broad dark belt west of the great hollow was of a deep reddish colour. The curved shading just below the hollow was all that could be seen of the Great Red Spot. The northern dark belt was considerably split up, and at one place, near the preceding limb was a dusky black spot. Power used 200.

Fig. III. represents Jupiter's surface on 1885, Feb. 19, 9.45 A.M.T. The definition was excellent. The most striking features were three dark markings on the southern edge of the broad dark belt. The most western was elongated, and the most eastern quite round, like the shadow of a satellite; the central marking was not so distinct as either of the others though near mid-transit. Two other dark markings were noticeable, one on the northern side of each of the principal belts. Power used 200.

Fig. IV. represents Jupiter's surface on 1885, Feb. 21, 10.16 A.M.T. The definition was not very good, except at times. The Red Spot was just going round the preceding limb, but was plainly visible. The dark marking on the south dark belt is the same as the preceding one of the three in the previous sketch. Equatorial light band seemed to consist of a series of festoons. Power used 200.

Fig. V. represents Jupiter's surface on 1885, March 18, 11.17 A.M.T. Definition fair. Most noticeable feature, dusky spot on the equatorial belt, as shown. Power used 200.

Fig. VI. represents Jupiter's surface on 1886, Jan. 22, 13.20 A.M.T. Definition very good. The Great Red Spot is just going off. The most noticeable feature is the manner in which the south dark belt becomes suddenly fainter to the east of mid-transit. Power used 200.

Note.—All sketches, except the first, were taken with an 8 inch refractor; focal length, 9ft. 11in.

Poisoning by Tinned Foods.

By E. H. Rennie, M.A., D.Sc., Professor of Chemistry in the University of Adelaide.

[Read April 6, 1886.]

In December, 1885, a family at Tanunda, S.A., who had partaken of some tinned fish (Machonochie's fresh herrings) were seized with violent symptoms indicative of an irritant poison. The portion of the fish which remained uneaten was forwarded to me by the President of the Central Board of Health for examination. Analysis revealed the presence of considerable quantities of tin—about 0·25 grain oxide of tin to a tablespoonful of fish—and traces of lead, the interior of the tin being much corroded. Under an impression, which seems to be a general one, that tin salts are poisonous, I gave the opinion that in the case referred to the symptoms were due to the presence of these compounds in the fish.

A very similar case occurred about the same time at Murrurundi, N.S.W., the symptoms having been caused by eating tinned fish of the same brand; but Dr. Ashburton Thompson (Medical Inspector under the Board of Health, Sydney) informed me that in this case there were some symptoms which could not be referred to an irritant metallic poison alone, and he at the same time expressed himself as more inclined to believe that all these cases were referable to animal poisoning. He at the same time pointed out that were they due to poisoning by tin compounds illness of the same kind would probably be much more frequent, the presence of tin in larger or smaller quantities having been so frequently recognised.

Since then my attention has been called to a paper published in a German periodical devoted to physiology (reference unfortunately lost), and to an abstract (*Lancet*, 1886, p. 455) of a paper by Dr. Patenko. In the former paper an account is given of experiments with two soluble tin compounds, viz., tin triethyl and the double tartrate of tin and sodium, on various animals, and it is shown that while the subcutaneous injection of these compounds gives rise to very serious symptoms, the administration of large doses by the mouth day after day produces little or no effect. In the latter paper an account is given of similar experiments with "bichloride of tin," with similar results.

These facts, coupled with recent investigations on the for-

mation of poisonous cadaveric alkaloids, or *ptomaines*, in putrifying animal and vegetable matter, lend considerable probability to the animal poison theory. In connection with this it may be mentioned that a member of the firm above referred to has stated—whether on sufficient grounds or not I cannot say—that all these cases of poisoning have occurred in the summer time, and when the fish has been eaten after the tins have remained open for some time.

It must be borne in mind, on the other hand, that the fish could not have been in such a state of putrefaction as has been usually considered necessary for the formation of ptomaines, otherwise it would have been quite unpalatable; and, moreover, I have been informed of cases of poisoning after partaking of tinned fruits—*e.g.*, pineapples (in which much tin was found), and in which, much sugar being present, it is difficult to understand how putrefaction could have advanced to such an extent as to produce the effects observed, without rendering the fruit quite uneatable.

There is still another suggestion as to the cause of these symptoms, viz., the presence of *living* poisonous matter, which has found in the foods referred to a suitable medium in which to grow and multiply. And here I may quote a case, an account of which was communicated to me quite recently by Mr. Hamlet, Assistant Government Analyst in Sydney, N.S.W. Some persons who had partaken of a tin of black currant jam were seized with symptoms of poisoning. A chemical examination failed to detect any metallic or other poison, but a microscopic investigation revealed the presence of considerable quantities of *fungi* of various kinds.

Obviously the matter needs investigation, but such an inquiry is beset with many difficulties. It is scarcely necessary to point out that if we are to arrive at any satisfactory conclusion in the matter, and to find a means of prevention, careful records of all cases should be kept, even of minutest details.

Notes on some South Australian Trogidæ, and a New Species of Trox.

By Mr. J. G. O. Tepper, F.L.S.

[Read July 6, 1886.]

The *Trogidæ* are a family of *Coleoptera* widely distributed, but are not attractive either for colour or habits. They are usually of a dull black, brownish, or grey, live on dry dung, skin, hoofs, or under putrid dead animals, but do not trouble man. In form they are oval, the back arched semi-cylindrically, and the elytra not only cover the whole body, but extend, in many species, in a fairly wide margin under the flat abdomen. In this case they are usually joined in the middle, the wings being absent. Whenever disturbed these beetles simulate death by drawing the legs tightly under the body, the head in a cavity under the prothorax, and the short antennæ (with three lamellæ) into a depression of the tibia of the front legs. No amount of torturing seems capable of startling them into motion. Central Australia, to the west coast, appears to produce the largest of the genus *Trox*, viz., *Trox* (*Phoberus*, McLeay) *gigas*, Har. (the species was kindly identified by the Hon. W. McLeay), of which two specimens are in the Museum, marked "Port Wakefield" and "Ardrossan" respectively. It is nearly an inch in length, and half as wide, dull black, with three rows of twelve or thirteen shining black conical tubercles on each elytron, generally arranged two, three, seven, or two, four, six, the four near the posterior extremity being much more prominent than the others, especially the medial two.

More than a year ago a gentleman from the neighbourhood of Eucla left some fifteen or sixteen specimens of similar beetles at the Museum, stating that they were obtained in the arid country one hundred miles north of that place. They are known there under the name of "Musk Beetles," as they emit a most powerful musk-like odour, which even now is still very strong. Some specimens were sent to the Hon. W. McLeay, in Sydney, who pronounced them as a new species. It differs from *Trox gigas*, though of the same size, or even larger, by a different serration of the tibiæ of the forelegs; the claws smaller and less spreading, and the form, position, and number of tubercles upon the elytra. Each of the latter bears fifteen to seventeen low oblong tubercles, nearly alike in height, in

rows of three, five, seven, or three, six, eight, besides three or one small one at the shoulder, so that the total number appears to be always eighteen.

As they cannot fly, it is difficult to conceive how in a country so thinly inhabited by animals as that where they are found, they can obtain sufficient food, unless they can resist starvation to an uncommon degree. This appears the case, for some of them still showed signs of life when they were handed to me, after they had been in possession of the donor for many months.

The commonest species about Adelaide is *Trox litigiosus*, Har.—a grey beetle half an inch long, and usually found under rather dry carcases of cattle or sheep. It is rather beneficial than otherwise.

Note on Ogyris Amaryllis, Newm.: an Addition to the S. Australian Butterflies.

By Mr. J. G. O. Tepper, F.L.S.

[Read July 6,, 1886.]

It is a notable fact that within some twenty odd years several butterflies, or Papilionidæ, have made their appearance here, which formerly were only obtained from Eastern Australia, as for example the red and black *Danais Archippus* and *Danais Chrysippus*. To these is now to be added the above, for in February last I received several specimens from the neighbourhood of Edithburgh, Y.P., by Mr. J. G. McDougall. They do not appear to have been rare at the time and place indicated above.

The species is described and figured in W. C. Hewitson's catalogue of Lycænidæ, 1862 (issued by the British Museum), page 3, Plate I., figs. 5 and 6, but the description as well as the figures only apply to the female, with which the specimens agree well. The male differs much, and appears to have been unknown to the authors cited. I append Hewitson's description of the female, and add that of the male:—

"*Ogyris Amaryllis*, Newman, MS.

"Upper side dark brown. Both wings from the base to beyond the middle light blue. [Upper margin of the same interrupted by a square patch of intense black at the end of the cell.—O.T.] The costal margin of the anterior wing—

[not in all specimens well defined.—O.T.]—and the outer margin of both wings white.

"Under side.—Anterior wing dark brown, lighter towards the anal angle; the apex and outer margin light grey, crossed by submarginal bands of brown; two spots of scarlet (bordered with light blue), and a white spot within the cell. Posterior wing light grey, clouded at the middle and outer margins with rufous brown, marked near the base with four spots of the same colour."

Male. Smaller than the female.

Upper side.—Both wings from the base light blue. The *apex and outer margin* of the anterior and the teeth of the posterior wings *black*, with a very narrow whitish fringe.

Under side.—Anterior wing dark brown, lighter towards the anal angle; the apex and outer margin light grey, crossed by *a very narrow marginal and submarginal* brownish band; *five narrow bands* (broadening from the base) *between the costal and discoidal vein*, the second and third blue, the fourth white, edged with blue, the remainder white. Posterior wing light grey, *with slightly darker interrupted bands, narrowly edged with black.*

On the Production and Measurement of Gold and other Metallic Spheres to Determine their Weight.

By Mr. G. Goyder, Jun.

[Read July 6, 1886.]

In making assays for gold where the amount of gold is very small a little silver is required in which the gold may be collected. As nearly all commercial litharge contains silver it is rarely necessary to add any separately for this purpose. The litharge I at present use contains at the rate of six pennyweights of silver and one-seventh of a grain of gold per ton.

Having obtained a prill in which the amount of gold is a third, or less than the silver, the prill is boiled in dilute nitric acid in a porcelain capsule, to dissolve the silver; and where the amount of gold is more than one pennyweight to the ton, a second boiling in strong nitric acid should be given. If care be taken in using dilute acid at first and boiling gently the gold will be left in one piece of a nearly black colour. The acid is now decanted off, and the gold washed two or three times with distilled water. The gold may now be placed on an aluminium or other polished metal plate by inverting the capsule and leading the last drop of water and the gold with a glass rod on to the plate; the water is drawn off by a piece of filter paper, and the plate gently heated till dry.

Having thus obtained the gold in a pure state, a bead is made with boracic acid on a platinum wire loop, and pressed on the gold while still red hot. The gold adheres without difficulty, and by heating the bead before the blowpipe the gold is obtained as an almost perfect sphere. Should the resulting sphere of gold be very minute it is better to measure it under the microscope while in the bead, but if large enough to be seen with the naked eye it can be measured more accurately after dissolving the boracic acid bead in a watch glass with hot water, and placing the sphere of gold on a glass slide.

The plan of measuring minute prills of silver and gold to determine their weight was first introduced by Harkort, who used an ivory scale engraved with two fine lines, meeting at an acute angle, and divided into fifty equal parts. According to the fifth edition of Plattner's "Probirkunst," page 520, Goldschmidt determines the weight of silver and gold prills by

measurement with the microscope. As I have not access to the paper on the subject his manner of preparing the prills for measurement is unknown to me. Harkort and Plattner in making scales for the determination of the weight of gold and silver prills weighed prills corresponding to the larger divisions of the scale, and from their weight calculated the weight for the smaller divisions. These prills were taken direct from the cupel, and at the point of contact are flattened, but as the amount of flattening is not always the same and hardly varies in extent with the size of the prill, and as the converging lines on the scale cannot be very sharply defined, this method is not capable of the same accuracy as where the almost perfect spheres are measured with the microscope.

No other flux seems to possess advantages equal to those of boracic acid for obtaining a sphere of gold. Borax and other fluxes are so fluid when hot that the gold is very liable to alloy with the platinum wire; this rarely occurs with boracic acid, on account of its great viscosity, even when white hot. Boracic acid is also easily soluble in water, so that the gold spheres can be separated without loss of time.

The following rules and figures may be useful to anyone wishing to adopt the system here described:—

1. The weight of a sphere increases as the cube of the diameter.

2. The weight of a sphere of any substance of which the specific gravity is known is obtained by multiplying the weight of a unit sphere of water by the specific gravity of the substance and the cube of the diameter.

Constants for use with gramme weights—

1 weight of a sphere of water 0·01 mm. in diameter= 0·0000000005236 of a gramme.
2. Weight of a sphere of gold 0·01 mm. in diameter= 0·0000000102102 of a gramme.
3. Weight of a sphere of gold 0·0x mm. in diameter, $x^3 \times$ 0·0000000102102 of a gramme.
4. If 20 grammes of ore are taken for assay the number of grains of gold per ton is found by $x^3 \times 0{\cdot}008004$ in which x=the diameter of the sphere of gold in hundredths of a millimetre.

Constants for use with grain weights—

1. Weight of a sphere of water 0·001 inch in diameter= 0·0000001324 of a grain.
2. Weight of a sphere of gold 0·001 inch in diameter= 0·000002582 of a grain.
3. Weight of a sphere of gold 0·00x inch in diameter, $x^3 \times$ 0·000002582 of a grain.
4. Two hundred grains of ore being taken for assay the number

of grains of gold per ton is found by $x^3 \times 0{\cdot}2045288$, in which x=the diameter of the sphere of gold in thousandths of an inch. By taking 978 grains for assay x^3= grains of gold per ton.

To test the accuracy of the above figures a comparatively speaking large sphere of gold from an assay was measured, and found to be 0·593 mm., or $\frac{59{\cdot}3}{100}$ of a millimetre in diameter, and $59{\cdot}3^3 \times 0{\cdot}000000102102 = 0{\cdot}002129$ of a gramme. When weighed on a very delicate balance it was found to weigh 0·0021 gramme, and as this balance does not indicate beyond the fourth decimal the results may be considered identical. This sphere indicated gold in the sample tried at the rate of 3 ozs. 9 dwts. 13 grs. per ton. The smallest sphere of gold I have yet measured was 0·024 mm. in diameter, and by applying the above rule the weight would be $2{\cdot}4^3 \times 0{\cdot}0000000102102 \times 15{\cdot}43235$ (to convert grammes to grains)=0·000002178, or a trifle over two millionths of a grain.

Spheres of silver may be obtained and measured in a similar manner; the boracic acid acts slightly on the silver, but the quantity dissolved is inappreciable, as the action is not prolonged. The specific gravity of silver being 10·53 the weight of $\frac{1}{100}$ mm. would be $0{\cdot}0000000005236 \times 10{\cdot}53 = 0{\cdot}000000005513508$ of a gramme. In a test assay made with silver the sphere measured $0{\cdot}57 = \frac{57}{100}$ of a mm., from which the weight deducted would be 0·00102096 of a grain, the balance showing the weight as 0·0010.

Copper, lead, and other metals cannot be melted in boracic acid on platinum wire without dissolving to a perceptible amount, but may with care be melted in sodic carbonate, and by dissolving the latter in hot water the sphere of copper, &c., obtained and measured.

On "The British Standards."

By Mr. R. B. Lucas.

[Read December 1, 1885.]

Plates VII.-XIII.

I need not lay any stress upon the importance of absolute accuracy of measurement, and especially of standards being accurate, and though to those unconnected with scientific matters such errors as are observed and corrected in verifying standards would seem unimportant, yet scientifically the dimensions treated of will be quite appreciable.

It has been found that "no two primary standards, even, have ever been compared between which some difference has not been found," and this being the case it becomes a question as to the limit of error, or put in another form, the amount of trouble to which it is advisable to go in order to obtain the highest amount of accuracy.

The British Board of Trade has settled that the limit of error to be allowed in the standard yard line measures is not to exceed ·003 of an inch, or $\frac{1}{12000}$ of the yard which corresponds to a range of temperature of 10° Fahr. The actual expansion of the metal of which primary standards are usually made is ·000341 inch for each degree of Fahr. This metal is a mixture of copper, sixteen ounces; tin, two and a half ounces; zinc, one ounce; and is called "Baily's metal."

To observe with sufficient closeness to note such dimensions, a comparing apparatus, fitted with microscopes, has been designed by Mr. Sheepshanks, a well-known authority in such matters, and is now in use at the Board of Trade offices at Westminster, where all the standards are kept.

When in London lately I met with the most courteous reception by Mr. Chaney, the warden of the standards, who has expressed and shown a willingness to distribute information on these matters that is highly praiseworthy. When it is possible to obtain valuable information from so high an authority given so generously it is unwise not to seek it. I accordingly made use of the opportunity, and am now in the possession of a mass of valuable information on the subject.

It was not until the year 1867 that the British Government saw the importance of establishing upon a firm and reliable basis a set of standards, devoting to the purpose a special

department of the Board of Trade, now called the Standards Department, and appointing a staff of officials to carry it on. The Commission, which was appointed to inquire into the matter, consisted of G. B. Airy (Astronomer Royal), chairman; Lord Colchester, Right Hon. S. Cave, M.P., Sir J. G. S. Lefevre, K.C.B., the President of the Royal Society (General Sabine), the Master of the Mint (Professor Graham), Professor W. H. Miller, F.R.S., and the Warden of the Standards (then Mr. Chisholm).

They carried on their labours for three years, and on July 30th, 1870, handed in their fifth and final report, bearing date 1871. This comprehensive report embodies the results of the work of the Commission during those three years, and is itself the basis upon which the Imperial Weights and Measures Act, of 1878, was constructed, and is, indeed, the foundation upon which the law relating to weights and measures of all British dependencies is constructed. Our Act, of 1885, just passed, is in all the technical detail entirely based on it. So are the Victorian, Canadian, and other Acts. It is from this source that much of the information for this paper is drawn.

With reference to extreme accuracy of measurement and the carrying of such refinements to a degree that practical people might consider an extreme, we have an example in the French system. French technical departments are distinguished for their tendency to carry on these "refinements of science," and their attendant theories. This tendency has borne magnificent fruit in the shape of the Metric system, and this not only of a scientific but of an eminently practical nature. There is little doubt that within the next few years the Metric system will have made great strides, as it has done within the last five or six years. An International Metric Bureau sits in Paris in September of every year, at which questions concerning the introduction of the metric system throughout the world are discussed, as also other questions of weights and measures. This system is legalised in England and the United States, and is in force in Germany, Russia, France, and numerous other parts of the world.

The state of the British Standards in 1758 is an illustration of the looseness and irregularity resulting from an uncertain system and imperfect supervision. They were compared by Mr. Harris, then Master of the Mint, having at that time been in use for 170 years. This was simply a comparison of one with another, and had no reference to any fixed or primary standard, such a thing being at that time without form and void. "It was found that such wide discrepancies existed when one standard was compared with another in whatever way they were tried that the operators immediately turned

their attention (as they themselves expressed it) to ascertain some standard which should be uniform and to preserve a due proportion as well in its parts as in its multiples."

Notwithstanding the defects in all these standards made in the reign of Elizabeth, they continued to be used at the Exchequer until 1825, when they were superseded by the standards then established by law, the standard of capacity having been again replaced in 1834.

It must be remembered that the comparison of these standards was conducted without any of the refinements now considered necessary, and I doubt if even a normal temperature was defined, or if temperature was observed at all, or if the effect of specific gravity was recognised in these verifications. The scales and other comparing apparatus must at that time have been of a crude and unreliable kind, as the results published in the fifth report of the Commissioners seem to indicate. Even in the smaller weights such large fractions of a grain as the quarter and half were very doubtful quantities.

The limit of error settled by the Commission for the one ounce troy weight is the $\frac{1}{4800}$, or ·100 of a grain, the same as for the one pound troy, which in the latter case is the $\frac{1}{57600}$ of the total weight, whereas the comparison referred to above shows that the errors between the standards themselves in the possession of the Exchequer amounted to, for the one ounce troy, the $\frac{1}{960}$, or half a grain.

It is specified that the balance used in modern verifications of such weights as one-eighth of an ounce up to one ounce is "a balance with gun-metal beams, steel knife edge, and agate planes, made by Messrs. Ladd & Oertling, No. 4, to weigh from one ounce to one grain, to turn with the ·005 of a grain." The vast difference between an observation which takes note of the ·005 of a grain, and that which is very doubtful about the ·250 of a grain is significant enough.

LENGTH.

If we look back to the origin of weights and of measures of capacity (for the idea of making capacity a scientific derivative of length or weight appears to be of very modern application) we shall find nothing but confusion, and no sign of concordance or system; but if we turn our attention to measures of length we shall find some indication of a natural unit of length, more or less vague, but the concordance is somewhat remarkable. Upon an examination of the diagram, Plate VII., the idea will suggest itself that the step or human stride, or the human foot, formed the basis of most of such measures among the countries or nations there represented. The most natural way of roughly estimating the distance from

one point to another on the ground is to pace it. Roughly, the foot will be found to be about the third of a step and approximate to twelve inches, which will allow for the rough covering in the form of sandals or shoes, and the step will be very nearly a yard. With reference to the metre 39·37 in., the estimated ten millionth part of a quadrant of a meridian, which corresponds very closely with the length of a pendulum beating seconds at the equator, viz., 39·013 in., it is only an arbitrary measure after all, and has after each careful measurement of an arc differed, but its approximation to the more primitive yard and three-foot measures suggests the idea that it originated in these; for the five-millionth or any other fraction on the quadrant might just as well have been adopted, for the matter of that. One reason of its adoption was that it closely corresponded with the measures in use at the time and previously. It is more than a coincidence. The diagram speaks for itself, and I need not delay over this any longer, but can proceed to a description of the British standard measures.

The excellence of a principle is in proportion to its simplicity; hence the metric system, which demands only one arbitrary unit, is superior in that respect to ours, which requires two., viz., length and weight. In the British system one arbitrary unit of length and one arbitrary unit of weight being agreed upon and fixed by Act of Parliament, all others are derived from these. Hence the yard and pound specially legalised by the Imperial Act of 1878 are called the "Primary Imperial Standards," and all others are called "Derived Standards," capacity being based on clause 15 of this Act, which specifies that the gallon shall contain ten pounds weight of distilled water under certain conditions.

The present standard yard and the pound are the result of natural evolution, their history having been one of progressively accurate definition from time to time by Act of Parliament. The French have broken this chain of evolution by the arbitrary selection of the metre as a unit, but, as shown above, even this has been influenced by its prior history. Their idea was to avoid such a thing as an arbitrary standard at all, and if the actual length of an arc could ever be obtained, the thing is accomplished (but this will never be done); and in pursuance of this policy the kilogramme* and litre as units of weight and capacity respectively were based upon the measure of a given weight of water, everything thus being based *only* upon the metre. In short, we have *two* arbitrary units, the French have only *one*.

---

*The Kilo = the weight of one cubic decimetre of water; and the litre contains one kilogramme weight of water.

The latest stage in the development history of the yard and pound is their definition by Act referred to above, as follows:—"The following standards were constructed under the direction of the Commissioners of Her Majesty's Treasury, after the destruction of the former Imperial Standards in the fire at the Houses of Parliament in 1835:—

"The Imperial Standard for determining the length of the Imperial Standard yard is a solid square bar, thirty-eight inches long and one inch square in transverse section, the bar being of bronze or gun-metal; near to each end a cylindrical hole is sunk (the distance between the centres of each hole being thirty-six inches) to the depth of half an inch. At the centre of this hole is inserted in a smaller hole a gold plug or pin about one-tenth of an inch in diameter, and upon the surface of this pin there are cut three fine lines at intervals of about the one-hundredth part of an inch transverse to the axis of the bar, and two lines at nearly the same interval parallel to the axis of the bar. The measure of length of the Imperial Standard yard is given by the interval between the middle transversal line at one end and the middle transversal line at the other end, the part of each line which is employed being the point midway between the longitudinal lines; and the said points are in this Act referred to as the centres of the said gold plugs or pins; and such bar is marked—Copper, sixteen ounces; tin, two and a half ounces; zinc, one ounce; Mr. Baily's metal No. 1 Standard yard, at 62·00° Fahr. Cast in 1845. Troughton & Simms, London.

"The Imperial Standard for determining the weight of the Imperial Standard pound is of platinum, the form being that of a cylinder nearly 1·35 inches in height, and 1·15 inches in diameter, with a groove or channel round it whose middle is about ·34 inch below the top of the cylinder, for insertion of the points of the ivory fork by which it is to be lifted; the edges are carefully rounded off, and such standard pound is marked P.S., 1844, one pound."

It is then provided that four copies of the above, made at the same time, should be disposed of as follows:—One copy at the Royal Mint, one at the Royal Society, one at the Royal Observatory, Greenwich, and one immured in the New Palace at Westminster.

The originals are located in a strong-room at the Standards Department of the Board of Trade, at Old Palace Yard, Westminster, just adjoining Westminster Abbey. An immense number of derivatives of these are in the possession of the Board of Trade, and also numerous standards of purely historic interest. All the weighing and comparing instruments are deposited in the Old Jewel Tower (in the basement),

adjoining Westminster Abbey, which was a monk's refectory in days gone by. All coinage standards and sample coins are located under lock and key in the Pyx Tower, close adjoining. The standard photometer, described further on, is fixed in a small room with groined roof, attached to the old refectory; this was probably used by the monks of those days as a retiring-room, or possibly as a lavatory. The walls are blackened, as is usual, with open photometers. All these walls are of immense thickness, and of considerable age, and are so well set that the long measures, such as ten feet, are set out on them, and the results are found to be most accurate upon comparison with other standards.

When it is remembered that the linear expansion of stone is about ·00000652 of its length for one degree of Fahr., it will be seen that a practically permanent distance is maintained between the contact plates of the measure. It must be pointed out that the principal reasons for using those rooms are that being underground they are less liable to changes of temperature, and from their solid construction and age are free from any vibration or settlement.

Bed measures (or end measures) are those measures whose extreme length indicates the measure, and which are accompanied by a bed into which they fit between two end blocks; thus a subsidiary measure is formed by the bed, while the principal measure is generally the rod or bar. The process of verifying an inside measurement in a case in which the bed was the principal measure was accomplished by Captain Kater, the well-known authority on such matters, as follows:—The bed was of brass, with rectangular steel terminations, and the bar of brass, one inch square. Two bars of brass three-quarters of an inch square and a little less than eighteen inches long each were prepared; their ends formed true planes at right angles to their length. Upon the upper surface of each bar very near the end, a fine transverse line was drawn; the other ends of the bars were then placed in contact, and kept so by a spring, as shown in drawing.

The distance between the lines was taken by means of two micrometer microscopes, fixed to a bar of wood, and referred to Sir George Shuckburg's scale, which Captain Kater affirms does not sensibly differ from the Imperial Standard yard (see Plate VIII.). It was found that the error was 919 micrometer divisions—each division equal to $\frac{1}{2\,3\,3\,6\,3}$ of an inch, or ·0000428 in. The two bars were then placed as shown in diagram No. 2 upon the standard to be examined, their marked ends together, and their opposite ends kept in contact with the steel faces of the standard by means of springs. Therefore the distance between the lines should, if the standard had been

correct, have equalled what the former distance lacked of three feet. The distance was measured, and from the mean of six observations was found to be 918·2 divisions of the micrometer, which Captain Kater says "differs so little from the 919 that this standard yard may be considered as perfectly correct." The amount of error was that the standard official yard was ·00003424 inch less than the Shuckburg scale, which error was of course not important enough to justify rejecting the measure. It was, however, considered by the Astronomer Royal that little importance was to be attached to the Shuckburg scale itself on account of its imperfections and the discordancies of its comparisons, and Mr. Sheepshanks (the designer of the present microscopic comparing instrument described below) did not place much trust in Kater's experiments, on account of the objectionable mode of resting the microscopical apparatus upon the scale. The idea of dividing a bar into approximate halves, as in this process, originated with Prof. Airy, the Astronomer Royal, who points out that "by placing two such end measures of a yard in a straight line end to end a line measure of a yard is formed, which may be compared with a line standard, and experience proves that line measures can be much more readily and accurately observed than end measures.

The microscopical comparing apparatus now used by the Standards Department consist of two principal parts—a travelling rest or stand for carrying the bars to be compared, and a fixed shelf of slate carrying four microscopes with micrometers, as per drawing (Plate IX.). The whole of the top part of the table, namely, the three plates of gun-metal, marked 1′ 1″ 1‴, and their connections, are enclosed after adjustment in a mahogany box, together with the measures to be compared attached to them, to prevent any variations of temperature during testing. As a further precaution a thick woollen rug is wrapped round this with holes cut in it for observation.

The micrometers of the microscopes were carefully rated, and it was determined provisionally that one division of the micrometer equalled ·00003173 inch—eventually settled at ·0000318 inch. This is the instrument used for the verification of line measures, or measures *à traits*, as they are termed; but for end measures, or measures *à bouts*, a specially-devised contact apparatus is employed. The instrument is made of brass, as per illustration (Plate IX.). By means of small contact pieces of steel, with fine lines engraved on gold studs upon them, the measures are converted into measures *à traits*. The contact pieces must first be *rated* by ascertaining the exact distance between the fine lines of the two pieces when in contact, and this constant always deducted from the observed measure gives the actual

length of the bar. (It has been found to be ·02014554 inch.) These contact pieces are not suited, however, for comparison of bars with square or rectangular terminations, and others have been prepared as shown in Plate IX., with small spherical projections. They are rectangular, and are made of gun-metal instead of steel. The distance between the lines in these studs has been determined to be ·099232876 inch. By means of these instruments measurements can be made accurately down to the ·00003187 of an inch, that being about the value of the micrometer division.

I need not detail the regulations to be observed for comparing standards by this instrument; it will suffice to say that most definite and precise instructions are laid down, and the greatest care is observed. The first observations are to be discarded, and only the subsequent readings to be taken as authentic.

The British Government, in rating the micrometer divisions, used an inch measure of Messrs. Troughton & Simms' very carefully divided into tenths and hundreds, together with a scale of its real errors. The defining lines upon their scales are cut upon silver, and like the lines in the gold studs of the Exchequer standards, are so fine that it is only in the strongest light that they are visible to the naked eye. To show the care considered necessary by this department, the breadth of the finest lines is nearly ten divisions of the micrometer, and the human hair is about 100 divisions.

The first work done by this instrument was the verifying the Victorian Standard yard in 1866, which is similar to the Imperial Standards, and is marked on sunk gold studs. I have seen this standard in Melbourne, and am of opinion that it is not a suitable form for these colonies. Under the Weights and Measures Act, 1885, which leaves the form of standard yard optional, and in accordance with advice received lately from Mr. Chaney, I am recommending a different form of yard measure.

The objection to the Victorian Standard is that to use it at all a comparing instrument similar to that above described is required, and this would be absurdly costly for us to employ; and again, there is no necessity for us to trouble about fourth decimals of an inch. The allowance of error recommended by the Commission in their report of 1841 was $\frac{1}{12000}$ of the whole, or ·003 inch to the yard. This corresponds with a range of temperature of ten degrees; and the necessary accuracy can be attained by means of much simpler standard known as the Canadian Standard, and marked S.S., which I am recommending, as mentioned above.

Amongst the instruments used in comparing lengths are the following:—An instrument for verifying measures of twenty

feet to ·01 inch, fitted with five microscopes and micrometers; calipers and micrometer for verifying measures of capacity; an apparatus for finding the expansion of metallic bars at varying temperatures from 32° Fahr. to 212° Fahr. Small test-glass used with micrometer microscopes, having minute subdivisions of the millemetre cut upon it, known as Nobert's lines. Nobert, the German optician, has ruled bands containing 224,000 lines to the inch; he regularly makes plates with bands consisting of from about 11,000 to 112,000 lines to the inch, numbered first to nineteenth, which are used as microscopic tests. It is of interest to note that the spaces between the lines on the nineteenth band are about half the length of a wave of violet light; and the length of such a wave being ·0000179 inch, and the micrometer being capable of measuring to the half of one division, viz., half of ·0000318, it follows that the yard can be measured to about the length of a wave of violet light.*

The department is furnished with a complete set of Whitworth's plugs and dies in form as per illustration (Plate X.), varying from six inches diameter down to ·1 of an inch by degrees of ·1 inch and ·01 inch. In connection with these is a set of three plugs and one die in a small case. The die is exactly one inch in diameter; one plug is exactly the same, but the other two plugs are 1·001 inches and ·999 inch diameter. The object of this is to enable one to judge of an accurate fit. Upon applying the plug one inch diameter I found that by keeping it moving, and turning it as I pushed it, I could pass the plug into the die and withdraw it; but if I allowed it to stop for a moment cohesion would take place, and some force was required to withdraw it.

When I applied the plug ·999 inch in diameter, it easily passed through, but without play, and without the experience of the one-inch plug would have appeared a perfect fit. The plug 1·001 inches in diameter would not pass in at all. These are all made by Sir Joseph Whitworth & Co., and are examples of perfect workmanship.

Wire Gauges.— With reference to wire gauges, dissatisfaction and uncertainty having previously existed, steps were taken under certain clauses of the Weights and Measures of 1878 to set this question at rest. At the Privy Council held on 23rd August, 1883, an order was made to legalise certain wire gauges, and establish them as standards under the Act; and although other gauges are in use, viz., a "Sheet and Hoop-iron Gauge" (South Staffordshire Ironmasters' Association), Stub's

* The periodical report by Board of Trade (of date February 6, 1882) refers to the subdivisions of the inch to the 100,000th by means of micrometer screws.

iron-wire gauge, and steel-wire gauges, no other but the Imperial Standard gauge is strictly legal.

Expansion by Heat.—General Baeyer some time ago pointed out a phenomenon with regard to the expansion of metallic bars by heat. He found upon careful verification of certain measuring bars used in measuring an arc of meridian that the co-efficient of expansion had sensibly decreased, while the length of the bars at their normal temperature had during twenty years remained the same. To explain this, he ventures three hypotheses—1st. That at each time the bars are subjected to increased temperature a step is made towards reducing the *temper* of the steel, and thus rendering it less expansive. 2nd. That a crystalline structure is set up by the vibrations and concussions these bars were subject to. 3rd. A somewhat complicated hypothesis, based on the fact that certain substances exist consisting of two sets of wholly different crystal systems, due to high and low temperatures, and that the bars remaining at ordinary temperature, there is a tendency to reduce the system of crystals to a third, corresponding to the medium temperature. He admits himself that this is least probable.

WEIGHTS.

The Imperial Weights and Measures Act, and Acts derived from this, specify the standard pound to be of platinum, and the weighing to be conducted in vacuo. The object of this will be evident—and is, of course, the elimination of the disturbing effect of specific gravity, and platinum being the densest of all metals is least influenced by the buoyancy of the air. As a matter of fact the comparisons are not usually made in vacuo, though provision is made for this, but careful observations of the barometer and thermometer are made and corrections applied —based upon the ascertained specific gravity of the compared and comparing weights. Indeed, to such a pitch of refinement and delicacy are verifications of important standards carried that the expansion of the metal due to temperature is observed and corrections are made for this. Professor Schumacher in his paper on "The Comparison of the late Imperial Standard Pound Weight with a Platina Copy of the Same and with Other Standards of Authority," read before the Royal Society in 1836, says:—"It is to be hoped that no pound will in future ever be declared a legal standard unless its specific gravity and expansion (the knowledge of which is indispensable, even for a single comparison with a good balance) are previously determined with the greatest possible precision."

As it has been decided that immersion in water is calculated to injure the standards, their density must be determined by

means of the stereometer, invented by M. Say, and used b Professor Miller. It is described as follows:—"It consists o two glass tubes of equal diameter communicating with eac other at the bottom. One tube is graduated by lines traced o the glass; it is connected on the top to a cup capable of bein closed airtight. The body to be tested is placed in this cup The volume of air in this cup is measured by means of mercur poured into the other tube, by which the graduated tube be comes a barometric tube. The volume of the weight is show by the difference of the volume of air before and after th standard weight is inserted in the cup. By means of thi instrument the specific gravity of soluble bodies, gunpowder &c., may be ascertained without injuring them."

In order, therefore, to ascertain the true relative weights as well as the actual weights of standards differing in densit when weighed in air, it is necessary to allow for the weight o the volume of air displaced by each standard. Thus, in weighin two standards of different material for the purpose of deter mining their relative weights, it becomes necessary to reduc these weighings to a vacuum by deducting the weight of th volume of air displaced by each of them.

The correction is to be made according to the formula, thu given by Professor Miller:—"If the weights of P and Q appea to be equal when weighed in air, then the weight of P – weight of air displaced by P = the weight of Q — weight o air displaced by Q." As a body when weighed in water weigh less than when weighed in air, by the difference of the weigh of air and the weight of water displaced by its volume, in th same manner a body weighed in air weighs less than whe weighed in a vacuum, by the weight of air which its volum displaces.

But the weight of air is affected by temperature, aqueou saturation, &c., hence the correction is to be ascertained fron the following data:—

1st. Mean temperature of the air during comparison.

2nd. The mean barometric pressure reduced to 30° Fahr., an corrected by deducting the pressure of vapour in th air.

3rd. The density of the metal of which each standard i composed.

4th. Its co-efficient of expansion.

5th. The apparent weight of each standard.

And the method of computing the weight in grains of ai displaced by each standard is by adding the logs. of the follow ing terms:—

1st. The given barometric pressure in air, corrected an reduced to 30° Fahr.

2nd. The given ratio of the density of the air to the maximum density of water.

3rd. The ratio of the density of the metal of which the standard is composed at 0° to its density at the given temperature, and co-efficient of the lineal expansion of the metal.

4th. The weight of the standard in grains, and by deducting from the sum the loss.

5th. The ratio of the density of the standard at 0° to the maximum density of water.

In these calculations the latitude of the place of observation together with its elevation above normal sea level have to be taken into account.

In order to observe the needle of the balance with an accuracy commensurate with such corrections as I have described, it has been found necessary to use microscopes.

To the balance known in the department as Barrow's Balance two microscopes with a single horizontal hair line have been attached, so that two persons can simultaneously observe each needle. Provision is made for illuminating the scale if required. A double glass screen is placed between the observers and the balance, and an arrangement is provided for shifting the pans from one arm to the other without opening the glass case in which the balance is contained. A holder is fixed to carry two thermometers, so as to adjust the bulbs to the level of the centres of gravity of the weights in each pan.

A vacuum balance to weigh up to one kilogramme (made by Oertling) was shown to me by Mr. Chaney, of which the drawing in Plate XI. is a sketch from memory. This, I understand, is only used occasionally as a test after the process above described has been effected. It is not in common use. A powerful air-pump, constructed by Troughton & Simms, was used in connection with this balance, and almost a perfect vacuum could be obtained. The glass is one and three-quarter inches thick. The balance is provided with thermometers, gauge, and arms for removing and changing the pans and removing the weights. These are not made air-tight by stuffing boxes, but are sealed by a 30-in. seal of mercury, which hangs down underneath the table. Very minute weights can be observed with this instrument. I was also shown a small scales weighing down to the 0001 of a grain, which is to carry weights up to one ounce.

The beam is formed of filaments as fine as hairs braced together for stiffness.

Another balance was shown to me, enclosed, as is usual, in a glass case; the scale was read by a telescope, by which means the observer could be removed twenty feet away from the instrument to avoid disturbing the temperature by the heat of the body.

The mode of using the scales is as follows:—The standard to be compared is placed in the left-hand pan and the comparing standard in the right-hand pan. The divisions and fractions of a division which would be pointed out by the index on the ivory scale attached, if the beam were allowed to come to a state of rest, are ascertained by taking the mean of the extreme of the vibrations when the extent does not exceed the limit of the ivory scale, and it is presumed greater accuracy is thus obtained than if the balance came to a state of rest. The standards are then changed from right to left-hand pans, and similar observations are made. The same process is repeated three or six times or more. Half the difference between these two means shows the difference between the two weights in divisions of the index or ivory scale, and this when converted into parts of a grain shows the actual difference in weight.

There are two gilt gun-metal copies of the Imperial Standard Pound deposited in the Standards Department, No. 31 of 1845, which is ·00008 grain heavier than the standard, and No. 34, which is ·000089 grain lighter. As the combined weight of the two standard pounds is thus correct to ·000009 grains, their mean weight may be assumed to be equal to the Imperial Standard, and to form a true basis of comparison. These weights have therefore been used for such verifications, the average of their weight being assumed to be absolutely correct.

It might at first sight be considered that a weight standard once proved correct would remain so practically for ever. But such is not the case, and variations have been proved to have taken place.

Weights will increase and decrease in weight according to whether they are used or not. If not used they increase by oxidation, and if used they decrease by wear. The official standard pound which had been in use since 1825, when compared in 1866 with Captain Kater's primary brass pound, No. 1, which had never been used, and of which it is a copy, was found in the mean of five comparisons to be ·90177 grain lighter. This has been assumed to be the loss of weight due to wear and tear in 40 years. I consider we must also assume that so careful an observer as Captain Kater could not have overlooked so great a difference. As an instance of increasing in weight, Captain Kater's pound, No. 5, was compared in 1824, and again in 1844, and in these 20 years it had gained ·0089 grains by oxidation, and upon comparing again in 1867 it had gained ·01698 grains in the next 23 years. The accuracy of this has been questioned, but there can be no doubt of an increase in weight.

An illustration of different forms of one-pound weights, half full size, is given (Plate XI.) to give an idea of their specific gravities.

CAPACITY.

The universal unit of capacity by which all liquids and dry goods shall be measured is the gallon defined in clause 15 of Act of 1878 as containing ten pounds of distilled water weighed in air at a temperature of 62° Fahr. and thirty inches barometer against brass weights. The single exception to this is the apothecaries' fluid ounce, being the measure of an ounce weight of water. This is the same as the troy ounce, and the apothecaries' grain is the same as the avoirdupois grain.

The gallon forms the basis of all liquid measures, and the bushel of eight gallons of all dry measures. The bushel is defined in Act of 1878 to be a hollow cylinder having a plane base, the internal diameter of which shall be double the internal depth.

There are three possible modes of verifying measures of capacity:—

1st. By lineal measurement and cubing the contents.

2nd. By measuring the quantity of water contained.

3rd. By weighing the water contained.

The first mode has seldom been resorted to, and is not reliable or capable of any accuracy. The second is the mode adopted in all ordinary verifications. The third is used in scientific verifications and researches, and though capable of ensuring the greatest accuracy of any system, requires careful observation and many corrections.

The second mode (measuring with water) is effected as follows at the Standards Department. The standard and measure to be compared are left together in the same room with the water to be employed for twenty-four hours, in order to secure equal temperatures. First, the standard is accurately levelled, and then slowly filled by a small syphon until the water appears slightly elevated above the rim. Any air bubbles are carefully removed with a quill. A circular plate of glass with a plane surface and a small hole in the centre in a depressed cup is gently slid over, pushing off any superfluous water. Any water appearing in the small cup in the centre is removed by a pipette. The measure to be compared is also accurately levelled, then filled with water, emptied and drained, and the water from the standard is transferred by a syphon. The syphon itself is similarly filled and drained before using. The object of this precaution is evident. The glass plane, with any water that may be on it, is now slid over the measure. The excess or deficiency is measured by means of a burette.

Weighing—the more scientific process—is implied by the Act of 1878, clause 15, which defines the size of the unit of capacity by specifying the weight of water contained therein. It therefore follows that this mode more closely conforms with the

spirit of the Act, and hence in any official scientific verifications this mode is adopted. The tare of the vessel to be examined, together with the glass plate, is taken, and this weight, together with the weight of water it should contain, is placed in one pan of the scales, and in the other the measure filled with water. The errors due to temperature and barometric pressure are observed, and balanced by means of weights in either pan, according as the error is plus or minus. If correct, the balance will be in equilibrium. As a difference of 1° Fahr. between 62° and 70° will occasion an error of from four to six grains in the gallon, or thirty-two to forty-eight in the bushel, the importance of observing the temperature will be evident.

The reason for specifying brass weights by the Act will be evident after the observations on specific gravity of weights, and it is done to fix the conditions; but as the specific gravity of water is very different to that of brass, it appears to me that consistency demands the same scientific accuracy in this point as in others, especially when it is remembered that as fine, or finer, corrections are applied which are due to other circumstances; and even the weighing of the platinum pound weight, which is so little affected by the buoyancy of the air on account of its great specific gravity, has to be reduced to vacuo.

Captain Kater, in his researches, takes the weight of brass as eight times that of water; the effect, therefore, of the buoyancy of the air upon the brass will be one-eighth of that upon the water, thus lessening the effect on the water by about one-eighth of the whole quantity.* The calculation to give the correction is $\frac{1}{2\,4\,9\,3\,0} \times \frac{7}{8} \times 70{,}000$ grains = 2·46 grains = the gain in the weight of water due to a depression of one inch of the barometer in one gallon. Since Kater's inquiries further researches have been made by other scientists, especially by Regnalt, whose results are accepted throughout Europe as authoritative. It is true that this correction may be made now in official comparisons, but I can find no account of it, and I omitted to ask Mr. Chaney if it were observed when I saw him.

With reference to the expansion of gases under varying conditions something has to be said further on under the head of gas measurement. The question of saturation somewhat complicates the matter, which would otherwise be simple and satisfactory; but with reference to water and the expansion of liquids generally there is little satisfaction. The expansion of water by heat is, as we know, subject to the, as yet, unaccountable phenomenon that from 32° to 39° it contracts, and from

* Water is taken as 831 times the weight of air; this, multiplied by thirty inches barometer for the pressure of air, gives 24,930.

that point upwards expands in the same ratio as it previously contracted, a fact which complicates finer researches.

Considerable difficulties have been experienced in obtaining consistent results in verifying the bushel. The chief seems to be the large area of the surface (viz., 18½ in. diameter), and the consequent difficulty of getting a true water surface. The drawing in Plate XII. shows a water-line indicator attached to a bushel measure. This is, I understand, now used in preference to the glass plate at the Board of Trade. The reasons of errors in these verifications of the bushel measure are as follows:—

1st. Its difference of specific gravity caused by absorption of air, &c., from the atmosphere.
2nd. The evaporation of the water during the time necessarily occupied by the weighings.
3rd. Variations of temperature during the weighings.
4th. Difficulty of obtaining an exact plane of the surface of the water.

The importance of the last will be seen from the fact that a difference of ·001 inch in the height of the water line makes a difference of 31 grains. In view of these facts it has been proposed by Professor Miller (as the process of verifying a bushel measure is most troublesome on account of the great weight of water, and the necessity of filling the standard exactly up to the brim) that a form of standard measure more resembling the cubic foot bottle, used in gas measurement, would answer better.

GAS MEASURING.

The Sales of Gas Act of 1859 provides that certain instruments deposited with the Board of Trade should be regarded as standards for the sale of gas, chief among which is the cubic foot bottle, as shown in drawing. And the unit is thus specified, Clause II.:—"The only legal unit for the sale of gas by meter shall be the cubic foot, containing 62·321 pounds weight of distilled water, weighed in air at the temperature of 62° Far., the barometer being at 30 in." And the next clause provides for the construction of this and derived standards, and their deposit in the Standards Office. The mode of using the cubic foot bottle is by placing counterbalance weights upon the chains. The tank containing water is raised, and the measure is thus immersed, and the air contents expelled through the outlet at the top (Plate XII.). As soon as the water makes its appearance at the neck (seen through glass plates) the outlet cock is shut and a cubic foot of air has been expelled. The secondary standards take the form of small gasholders of five or ten feet capacity, carefully made and provided with a scale of cubic feet, divided into tenths and hundredths. The principal diffi-

culty exists in accurately graduating this scale for a particular bell, as the disturbing effects of varying temperature, &c., affect the result. The laws laid down by Boyle, Gay Lussac, and others that all gases expand and contract the same for the same temperature, that expansion is in direct ratio to the absolute temperature, and that the bulk is in inverse ratio to the pressure, only hold good so long as the gas under consideration is a perfect gas, and as soon as the vapour element is introduced all this is modified. As it happens that in practice gas and air are always more or less saturated with aqueous vapour the normal state must be taken as that of saturation. To meet this difficulty the Astronomer Royal in 1861 compiled a table of expansions of gas in contact with water at various temperatures, based upon factors supplied by J. Glaisher, F.R.S. It is said to be calculated in accordance with the best modern theories. It is the table used in official verifications of local standards at the Standards Department, and is found in all practical treatises on gas manufacture, but is of course not used in the scientific comparisons and verifications conducted at the department, as it is only calculated to one-half per cent., and much closer observations are required. As an example of the dilation I give an extract from the table:—

A volume of gas at	32°	Fahr.	increases at	42°	by	2½	per cent.
"	32°	"	"	52°	"	5	"
"	32°	"	"	62°	"	7½	"
"	32°	"	"	72°	"	10	"

or about 2½ per cent. for each ten degrees of Fahrenheit. As the dilatation of pure or dessicated gases is in direct ratio to the absolute temperature, which is found by adding 459 to the Fahrenheit temperature, it will be found that the volume of a pure gas at 32° will increase 2·036 per cent. for every ten degrees of Fahrenheit, as against 2½ per cent. in the case of saturated gases.

In order to calculate such a table the amount of aqueous vapour in the air must be ascertained by determining the temperature of the dew point. This is done by means of M. Regnalt's hygrometer, as used by the British Standards Department (Plate XII.). It consists essentially of two test tubes of glass, each fitted with a silver thimble. Ether is poured in that marked *b*, and the air or gas bubbled through it; the temperature is thus reduced until dew is observed upon the silver thimble, and the temperature is observed by the thermometers. Of course the lower the temperature required to deposit dew the less vapour exists in the atmosphere or gas being tested.

The mode of verifying a cubic foot measure is very similar to that employed in weighing the contents of a bushel measure, and similar corrections are required. But in verifying the

derived measures, viz., the one cubit foot, the five cubic foot, and ten cubic foot holders at the Standards Department, the greatest precautions were taken to maintain the temperature of the water in the tanks of the holders and in the cistern of the cubic foot apparatus, the same as that of the air of the room by means of hot and cold water properly mixed. But with all these precautions, and the use of screens to keep the heat of the body from affecting the contents of the bells, there was frequently a difference of 1° Fahr. between the two measures.

The great difficulties experienced in maintaining a body of water at a uniform temperature led the Board of Trade to instruct the Cambridge Scientific Instrument Company to conduct experiments with a view to solve this question. The report of their inquiries, dated December, 1885, shows that the maximum variation of temperature in fourteen days was ·04° centigrade, while the variation in the room itself was about 4° centigrade. This was effected automatically, and the results are satisfactory so far.

In the first case water is used as a means of comparing the measures, as in the bushel measure, but in the latter saturated air has to be used, hence the difficulty is augmented.

The limit of error for official standards proposed by the Astronomer Royal and approved by the Treasury is ·005 for the cubic foot, ·025 for the five cubic foot, and ·05 for the ten cubic foot. As the errors in the above standards were proved to be, for the one cubic foot, —·00053 cubic foot; for the five cubic foot, —·00667 cubic foot; and for the ten cubic foot, —·02495 cubic foot, they were passed as correct, but these errors are allowed for and taken into consideration in using these standards.

Although these, viz., the cubic foot bottle and gasholders, are the only forms specially legalised, Clause III. of the Act gives power to adopt other forms, and under this clause "secondary derived standards" have been constructed and adopted, with the object of obtaining a portable standard. They take the form of wet meters, and are capable of almost absolute accuracy, as I have found myself. At our Standards room we have a 50 light and a 100 light meter as models under the Act of 1881, which were made by Alex. Wright & Co., and are very satisfactory.

COINAGE.

Amongst other standards of weight are coin weights, corresponding with the standard weight of each coin of the realm, and with these the coin weights used by Banks throughout England and by the Mint are verified.

The duty of verifying coin weights used by the public was

originally conducted at the Mint, but since the establishment of the Standards Department of the Board of Trade it has been relegated to that Department. I was informed by Mr. Chaney that sample coins are taken at haphazard from coinings, and deposited in a strong room in the Pyx Tower; at the end of the year they are taken out and verified carefully; by this means a check is maintained upon the accuracy of the work at the Royal Mint. As a rule these trials prove the errors, as to weight and fineness of the coins, to be far within the allowed limits, and I doubt if any case of condemning has occurred within late years. Glass weights are sometimes used by tradesmen to test gold coins.

LIGHT.

An Act of 1859 provides a standard of light, and modes and apparatus for testing lights. In accordance with this the necessary standard burners, photometer, &c., are deposited, amongst other standards, with the Board of Trade. The drawing in Plate XIII. will show one of the two authorised forms of photometers and the form of burner. The legal standard of light is the sperm candle of six to the pound, burning 120 grains of sperm per hour—the consumption of gas has to be adjusted to five feet per hour. The candle has been proved to be a most unsatisfactory standard, and there is at present a strong feeling in favour of some other form being legalised. The opinions lie between the Pentane standard of Vernon Harcourt and the Methven slit, which are the chief competitors.

Attention has lately been drawn to F. von Hefner Alteneck's amylacetate lamp, the extreme variations of which are claimed to lie within the limits of perception of the human eye, whereas the candle (the existing standard) is liable to variations as great as 23·7 per cent. in extreme cases, which would make eighteen-candle gas appear to be either fourteen or twenty-two candle power; whereas the eye is, if properly assisted, capable of judging to within about a fifth of a candle in eighteen-candle gas (say about one per cent).

For cannel gas a burner specially constructed is legalised.

The Pentane standard of Vernon Harcourt consists in using a specially-prepared gas from highly-rectified petroleum, which, burned under certain fixed conditions, he claims, gives a constant unit of light. John Methven's system is based on the assumption that by cutting off from an ordinary argand flame all but the central rays of light, by interposing a screen having a slot of fixed size, a constant unit is thus obtained. I found amongst authorities I met in England a very strong feeling in favour of the latter; and it is used at numerous testing stations throughout England by Companies and Corporations, but is not yet included in the British Standards.

An immense variety of propositions have been made from time to time with the object of establishing something like a definite unit of light, but up to this time with only partial success. The International Congress of electricians, assembled in Paris in May, 1884, adopted the proposal of M. Violle, fixing as the unit the quantity of light emitted by a thread of platinum of a thickness of a square centimetre heated to melting point, and tested at the moment of cooling; but difficulties occur in this which will effectually prevent it remaining the ultimatum.

It is a field of inquiry that to many scientists has a great fascination, and is now attracting much attention from specialists. I met persons in London who devoted the greater part of their time to researches in this direction, which will seem, however, to the general public a somewhat restricted specialty.

Some systems which have been proposed are as follows:—Keat's standard sixteen-candle oil lamp, the French Carcel oil lamp, Crooke's radiometer, the selenium photometer, Lewis Thompson's one-candle standard lamp, &c., &c.

The British Standards Department, besides carrying on the duties indicated above, give attention to such matters as the following:—Advising all British dependencies as to the best course to pursue in all matters relating to weights and measures; issuing reports periodically as to the business done under the Act, together with instructions and advice to inspectors as to the best mode of carrying on their duties; directions for testing all descriptions of weighing-machines; adjudging limits of errors to be allowed in weights and measures; inquiring into questions of various metal gauges and screw threads from time to time; attending international conferences in Paris and elsewhere as to the metric system, unification of longitude, &c.; testing petroleum-testing apparatus; conducting numerous scientific researches as to expansions and contractions of metals and other substances, together with other matters. It will be seen from this list that the scope is very wide and comprehensive.

CONCLUSION.

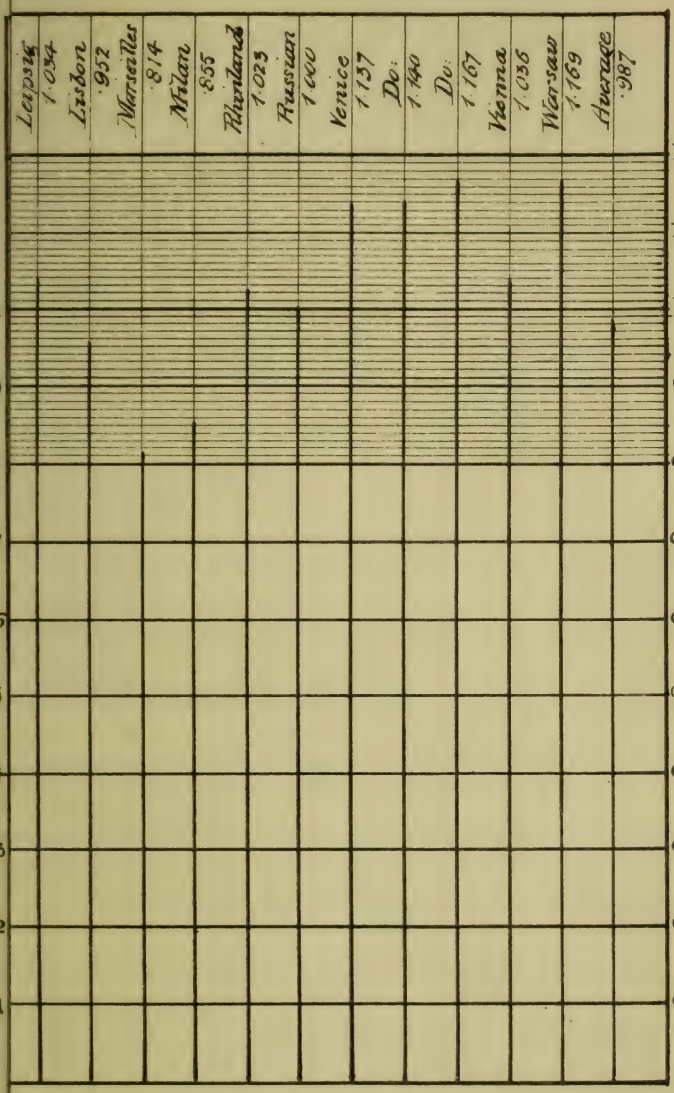
I have now described the British Imperial system of standards, which is, so far as it goes, excellent. But theoretically it is far from perfect. Standards of length, weight, capacity (dry, fluid, and gas), and light are alone represented; but an ideal system would represent besides these electric units and meters, atomic units, musical pitch, time, alcohol, temperature, motion and power, &c.

With regard to electricity, a unit is now taking form, and

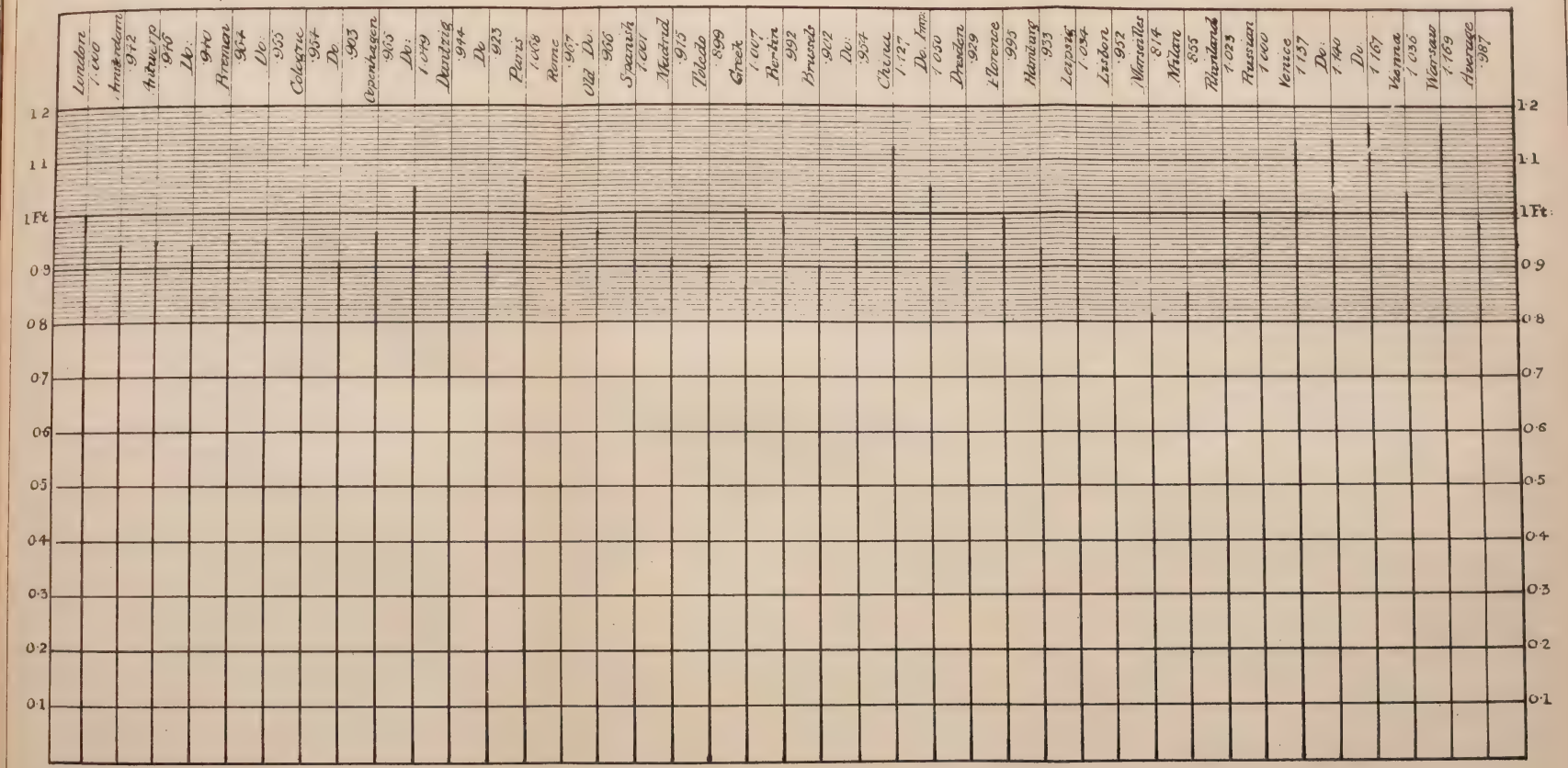
something has already been done to secure his. The B. A. Ohm was determined in 1862, and since this period improved Ohm-meters have rendered possible the more exact measuring of that amount.

As to musical pitch, efforts are now being made to settle a universal pitch, and this, when effected, can easily be represented among other standards.

The possibilities of such a department as Standards Department of the British Board of Trade are unlimited, and as a power to reduce to order the various systems of the world its importance cannot be over-rated.


Leipsic 1.034
Lisbon .952
Marseilles .814
Milan .855
Rhineland 1.023
Russian 1.000
Venice 1.137
Do: 1.140
Do: 1.167
Vienna 1.036
Warsaw 1.169
Average .987
1.2
1.1
1 Ft.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

R.B.L.de



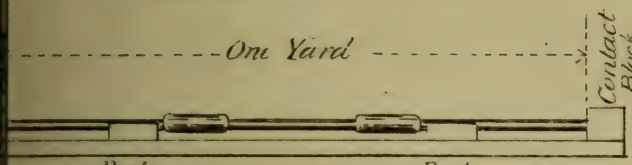
DIAGRAM

SHOWING COMPARATIVE LENGTHS OF FEET OF

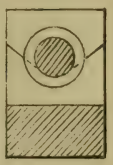
VARIOUS COUNTRIES

R.B.L. del.

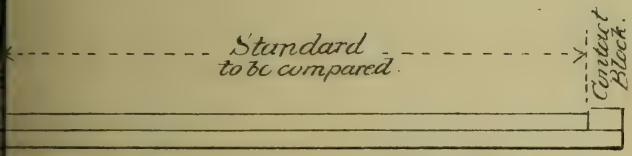
ORDINARY BED STANDARD.



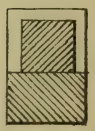
Steel Bed with Bronze Bar
Scale 1 in = 1 Ft:



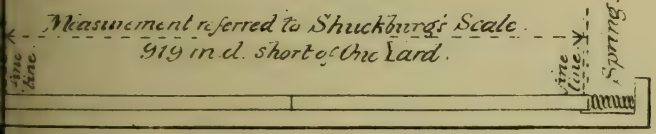
Section
3 in: = 1 Foot.



Brass Bar 1 in: square and Brass Bed.
Scale 1 in: = 1 ft:

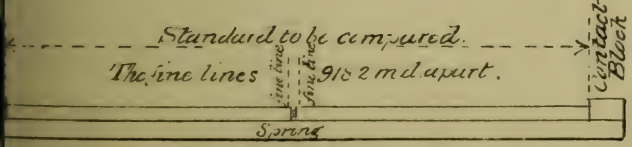


Section.
3 in: = 1 ft:



Nº 1.

Two Brass Bars 3/4" Square.
Scale 1 in. = 1 ft:

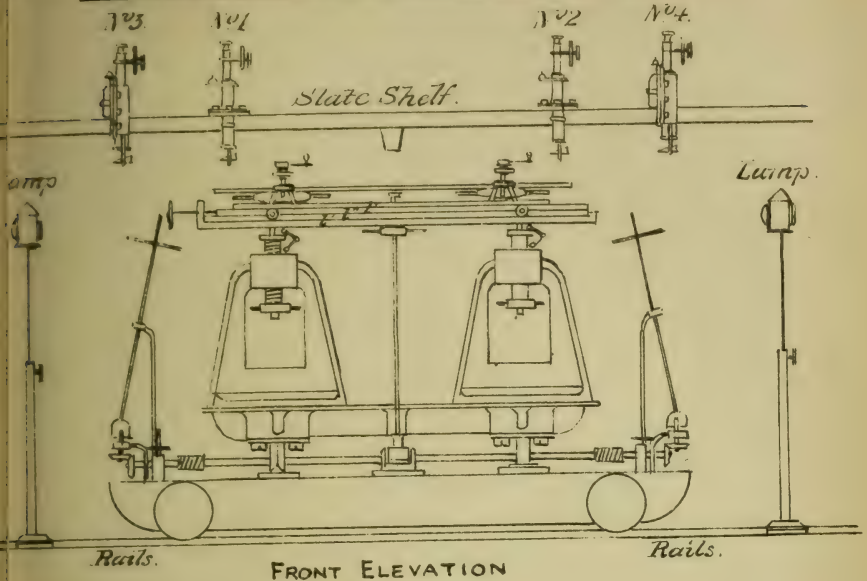


Nº 2.

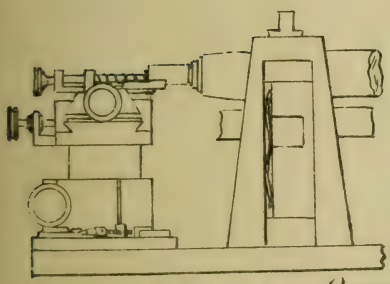
L. del[t]

Two Brass Bars 3/4" square.
Scale 1 in = 1 ft:

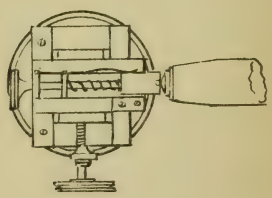
MICROSCOPIC COMPARING APPARATUS.



FRONT ELEVATION
Scale 45 mm

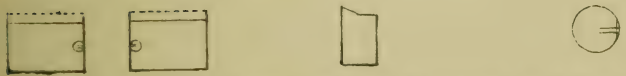


ELEVATION. (One quarter full size.)



PLAN.

CONTACT APPARATUS.

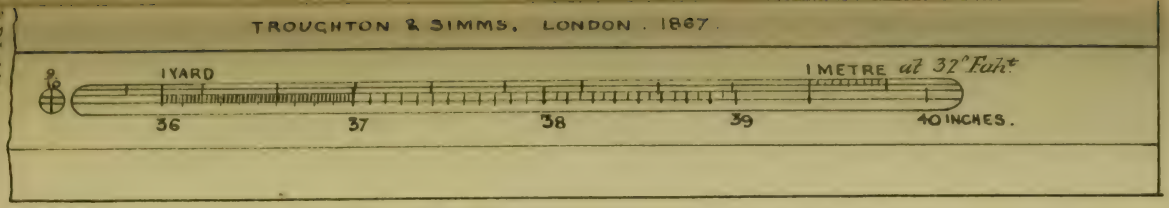


CONTACT PIECES FOR SPHERICAL ENDS.

R.B.L. delt.

CONTACT PIECES FOR SQUARE ENDS.

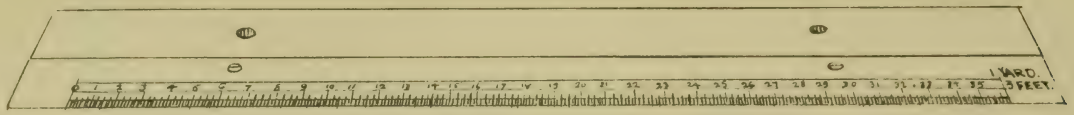
Plate X.



THE CANADIAN STANDARD S.S.

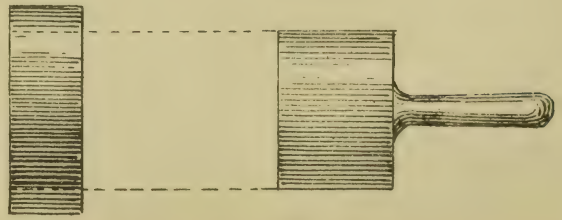
RIGHT HAND END OF UPPER SURFACE OF BRONZE BAR WITH YARD & METRE SUBDIVISIONS.

TRANSVERSE SECTION OF THE BAR.



FORM OF BEVELLED EDGE STANDARD.

WHITWORTH'S GUAGES.

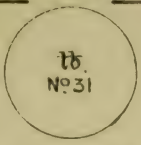


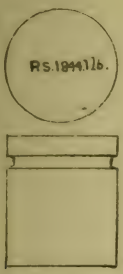
COLLAR. PLUG.

R.B.L. delᵗ

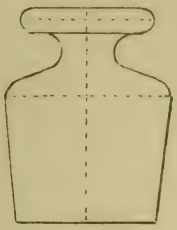
5 STANDARD AND OTHER POUND WEIGHTS.

OF VARIOUS SCALE — MATERIALS. ½ FULL SIZE.



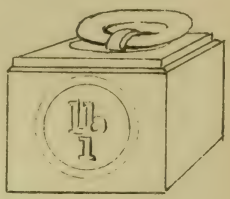


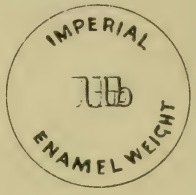
IMPERIAL STANDARD PLATINUM POUND.

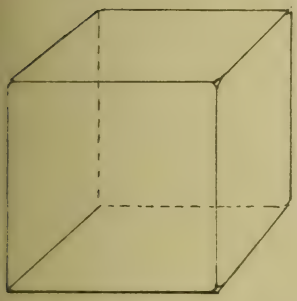


OFFICIAL STANDARD GILT GUN METAL POUND

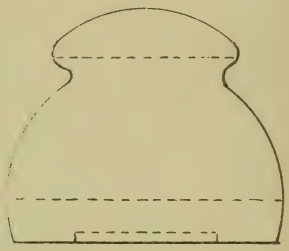
ORDINARY IRON TRADESMANS WEIGHT



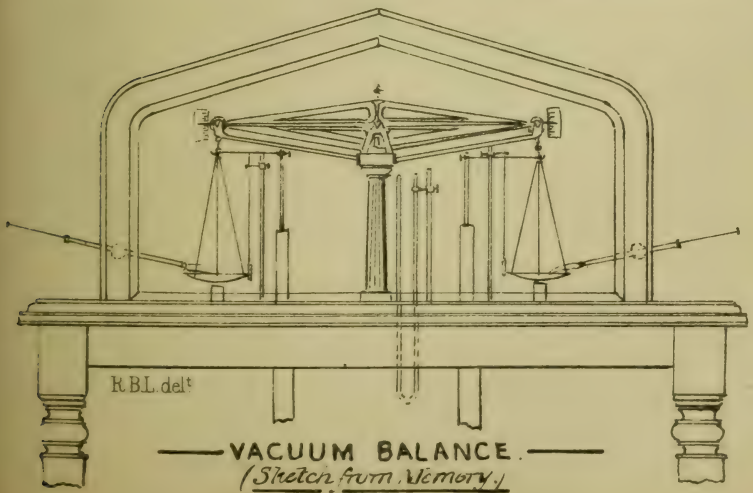




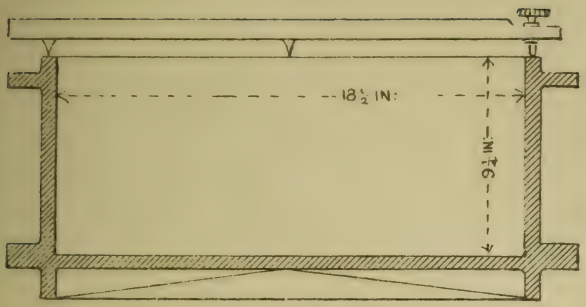
QUARTZ POUND WEIGHT.



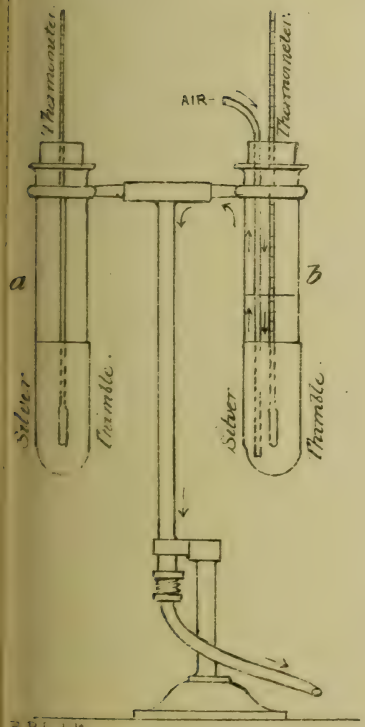
ORDINARY EARTHENWARE TRADESMANS WEIGHT.



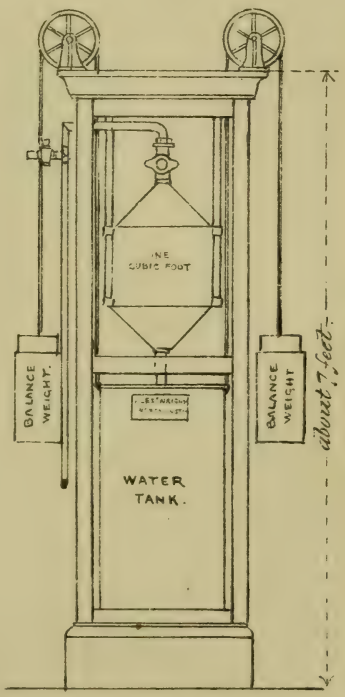
VACUUM BALANCE.
(Sketch from Memory.)



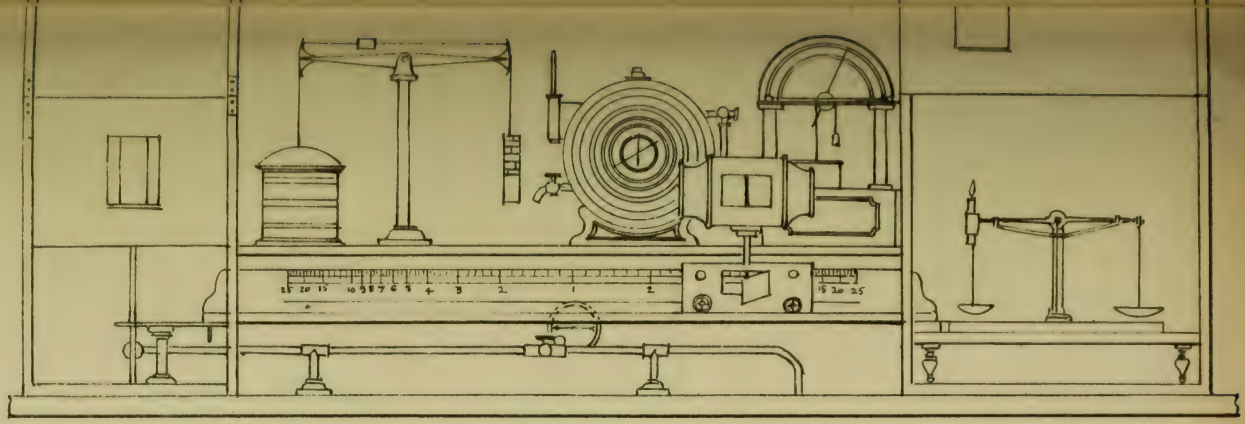
SECTION OF
IMPERIAL STANDARD BUSHEL.
With Water Line Adjuster.



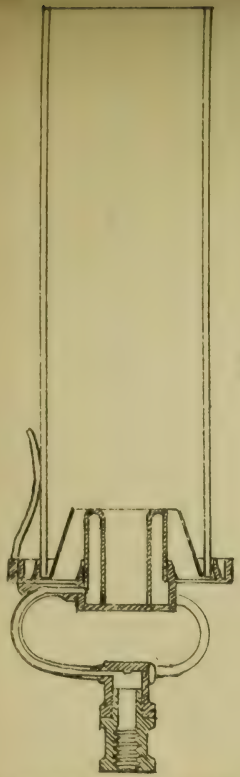
R. W. L. delt.
M. REGNALTS HYGROMETER.
One third of real size.



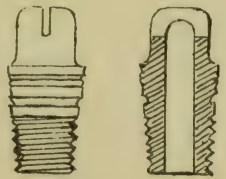
STANDARD CUBIC FOOT
BOTTLE.



LETHEBY BUNSEN
OR OPEN PHOTOMETER.



LONDON STANDARD
ARGAND BURNER.
(HALF FULL SIZE)



(FULL SIZE)
STANDARD BURNER
FOR
CANNEL GAS.

METHVEN'S
ILLUMINATING
POWER
STANDARD.

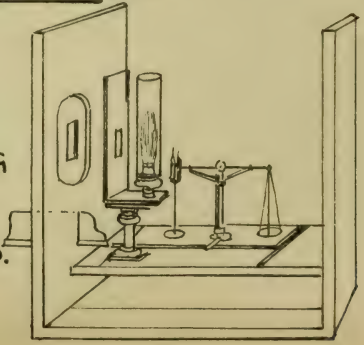


Plate XIII.

Sketch of the Geology of the Southern and Western Parts of the Lake Eyre Basin.

By Gavin Scoular, Corresponding Member.

[Read September 7th, 1886.]

Plate III.

The following notes were made in the course of a journey which I undertook in September last as far north as Anna Creek and Mount Margaret.

Geology of the Country Around Farina.—The secondary beds thin off to the south, dying out about ten miles south of the Railway Station. The higher lands in the neighbourhood are chiefly occupied with hard calcareous beds, apparently non-fossiliferous, whereas the flats, which have been denuded by Leigh's Creek, consist of a powdery gypsiferous material.

Geology of the Country passed through between Farina and Anna Creek Head Station.—For the first thirteen miles we passed over a plain of very uninteresting country to the geologist; there then appeared in the distance, to the westward, white gypsiferous cliffs, which to some degree relieved the monotonous aspect of the landscape. We shortly after entered upon the low swampy lands of Hay's Creek. After crossing it we halted on a small sandhill on the eastern side, about two miles above its junction with Leigh's Creek. Mount Nor'-West now began to loom ahead in the distance to the north-west.

By making a detour I had the opportunity of examining the *debris* of a deserted well, which had been dug in the thin covering of secondary strata which rests upon the primitive rocks a little below the crossing place, but did not find any fossils nor discover anything interesting about the material which had been taken from it. After crossing the creek we travelled upon a ledge of old primitive rocks which runs across the bed of the creek from 15 to 20 yards. No doubt these beds constitute a portion of the old slate series, which appear from beneath the cover of secondary beds far more frequently in the north country than is generally supposed. The strike of these beds is approximately north and south, and the dip is westerly.

We then ascended a slight rise, from 15 to 20 feet, on to a stony plain of secondary age that stretches away for several

miles to the north. This plain, which seemed to be almost level for a distance of about two miles after leaving the creek, begins to rise before reaching the gate leading into the sheep paddock, about one and a half miles north-east of Mandowna Railway Station. About 40 yards within this enclosure fundamental rocks of a dark purple colour appear at the surface, having a strike, as determined, of 45° west of north, and a dip of 80° westerly. From the general appearance of the country north and north-east of this place, these beds are extended much further in these directions, probably constituting the greatest part of the highlands between this point and the River Frome. Passing on in a westerly direction, the surface still rising and consisting of secondary strata, we bore straight for the eastern side of Decoy Hill, the northernmost summit of the Mount Nor'-West Range, and about four and a half miles slightly west of south from the Boorloo Springs.

On ascending Decoy Hill, I found it to consist of a very hard quartzite. I also found that on both sides of the band the material was slightly less metamorphosed, and thinly bedded, whilst the centre of the band was very hard and compact, carrying blocks of considerable thickness; strike, 50° west of north; dip, about 80° westerly; estimated thickness, about 200 feet; locality, about four and a half miles—from 20° to 30° south of west from Hergott Railway Station. The water of the largest of the Boorloo Springs possesses very nauseous properties, presumably due to salt and sulphurous ingredients. We stood by the spring and observed its motions carefully for a short time, and noticed as its waters were liberated at the surface of the pool an intermittent or an occasional puff of gas was set free, indicative that gas of some kind was generated in their passage to the surface. Besides salt and sulphurous matter, the waters of the springs must hold a considerable percentage of lime in solution; for the travertine thrown down around the outlet of the springs has already accumulated to a height of from eight to ten feet above the level of the surrounding plain. We ascended another, which is situated a short distance north-east from the main spring; also a third, which seemed to be left in its primitive state, located a few yards distant from the last, and estimated that the outflow of the two smaller ones is barely equal to the discharge of water from the main spring, though to all appearance the travertine collected around them is quite as great as the mound around the larger spring. This may indicate that they are in process of extinction, or that they have been longer in existence, if the discharge of water has been equable from their commencement. The quartzite band we had seen at Decoy Hill is continued in a northerly direction

quite as far as the Boorloo Springs, which in its course appears on the rising ground about three-quarters of a mile westerly of them. Here it has become metamorphosed into a quartz.

Leaving the Springs, we proceeded crossing a flat about three miles north-west of the Hergott Railway Station, and followed the track leading nearly west over a tableland until we abruptly descended into Collanna Creek. The eastern section at this creek has, at a distance of about seventy yards from the bed of the creek, an altitude of about one hundred feet. The lower portion of this section consists of a clayey material, with flakes of selenite scattered throughout, evidently the waste of an argillaceous bed, the upper portion consisting of variously-sized pebbles, averaging from four to nine inches in diameter. The wasting away process is here carried on more rapidly in the clayey deposits than it is in the conglomerates, hence the latter become undermined, and finally fall in large blocks, soon to become disintegrated, the pebbles getting profusely scattered over the slopes and base of the cliff. Further up the creek, but on the opposite side, there is a bluff of secondary strata, without the conglomerate cover, higher than the other including its capping of pebbles. The presence of these conglomerates imbedded on the surface of the plain at so high a level above the bed of the creek leads me to suppose that before the ravine was cut through the secondary beds, the creek emptied its waters over the plain at this place, hence the presence of boulders of a primitive type so high above the level of the modern channel.

Leaving Collanna Creek, for a short distance we passed over an undulating, or rather a knolly country, similar geologically to the foregoing, excepting that there were not so many stones of a primitive character scattered over the surface. On ascending any small height we could descry in the distance to the south hills presenting a semi-chalky aspect on their northern slopes. Coming to the Welcome Springs we found them situated in a valley about twenty feet below the level of the plain. The question arose, from whence came so large a volume of water sufficient to cut a channel deep enough to expose and liberate the waters of the various springs? A moment's reflection led me to consider that I had seen hills and tablelands to the south and south-west sufficiently high to collect and discharge from their summits flowing water, which in time may have scooped out a channel of these dimensions across the plain, and deep enough to liberate the waters of the springs. The water from the largest spring was a little more palatable than that we got at the Boorloo, though it has a peculiar sulphurous taste and smell. Travertine in large quantities has been thrown down around the two lesser springs which I examined, whilst very

little is accumulated around the outlet of the chief or great spring of the group. It is therefore my opinion that the lesser springs at some former period constituted in turn the chief spring, and that when the accumulation of travertine ascended to a height sufficient to prevent, in a great measure, the free outflow of water from them it found its escape in another place on the flat where less resistance was offered to its outflow.

Following the leading track across the plain as far as Kindeber Creek, we continued our course until we reached the Wangeyanna Springs. These springs occur in a valley or ravine very similar to the Welcome, but the outflow of water is not so great. The water, though alkaline to the taste, is far more palatable than either those at the Welcome or Boorloo. Gradually ascending we obtained a fine view of Pole Creek Range ahead. When flooded the Pole Creek must pour down enormous quantities of water on account of the large extent of highlands that are situated around its sources. The Davenport Springs, which we next reached, are distributed over the bed of the creek for the length of a quarter of a mile. Through the evaporation of their waters a goodly amount of white saline material has accumulated over the bed of the creek in the vicinity of the springs. The water of the chief spring of the group is not very palatable. It is nevertheless considered to be of fair quality for stock purposes. To the south-west of the main spring, at a distance of less than 300 yards, a bluff of fundamental rocks occurs, consisting chiefly of old, dusky, and purple-coloured slates, with a quartzite band of no great thickness interbedded, the latter giving a bold outcrop and peculiar prominence to the whole. The strike of the quartzite is 10° south of west, dip 67° westerly.

About two miles down the Davenport, on the eastern side, fossil shells of secondary age were found scattered about on the surface of a gentle rise. Indeed, it seems that wherever the argillo-calcareous prominences occur fossils may be found. As we passed to the north-east of the Finniss old head-station we came upon drift and numerous sandhills. To fully account for the drift sand, the country must have been partially covered with desert sandstone after the secondary marine strata were deposited. The winds and waste of centuries have perfectly disintegrated the once consolidated eolian deposits, and, so far as can be observed, no remains of the solid parts of the formation now exist in the neighbourhood.

On the western side of the creek, near Humphrey's Springs, several of the argillo-calcareous knolls occur, with abundance of fossil shells belonging to various species. This is the most prolific spot I have seen in the north for fossil shells. A few paces north-easterly from these low hills or knolls, on the south-western

side of the creek, a section of the secondary strata is exposed from eight to ten feet in height. Although in close proximity to the knoll which yielded the greatest variety of fossil species, none were discovered in the face of this section. The lower portion of the section consists chiefly of soft clayey material, whilst the upper beds are composed of much harder rock.

Quitting this place, and following the bed of the stream about fifty yards to the north-east, I discovered a band of old rocks running across the bed of the creek, the strike of which was found to be 10° north of west, dip 45° to the south. A reversal in the dip of the primitive beds between here and the Davenport Springs can only be accounted for by the fact that the Humphrey's Springs beds are situated further to the north-east in the old series of beds than those occurring at the Davenport Springs with an anticline intervening, causing the alteration of dip between the two places. From the large amount of saline matter deposited over the bed of the creek, it might be considered that the waters from the springs would be far less palatable than they are.

After leaving the springs we crossed to the northern side of the Gregory, from which position we could look back and see the hill of primitive rocks, which constitute the range south-west of the Davenport Springs, dipping under the secondary beds to the north-west. The Priscilla Springs were next reached. Here a considerable quantity of mineral incrustations is spread over the bed of the creek, caused by the evaporation of the waters from the springs, around which sand and sandhills abound. The flow of water is not great, but is very fair in quality. We passed within a mile of Lake Phibs, the waters of which, I was informed, are very salt, and that in the centre of the lake there is an island with a spring of very salt water upon it. We crossed Stuart's Creek a little above the highway crossing, the north-western bank of which rises in places from eight to ten feet high. I had been informed that fossils were to be found here, but although I looked carefully for such I observed none. The non-fossiliferous character of the deposits at this place does not by any means imply a similar absence of fossil remains further up the creek.

Passing Stuart's Creek we crossed the Margaret River, and afterwards came upon more knolls containing fossils. For several days from this point we passed over a succession of arid plains almost bare of vegetation, making a detour of about two miles in a more westerly direction by the Mount Hamilton cattle yards, after which we crossed a creek and passed over a very stony plain to the Warburton Springs, from the chief of which a considerable volume of water flows, but soon disappears through evaporation and absorption, not reaching beyond the

bare claypan, which is now covered to dazzling whiteness for an area of several hundred acres with an incrustation of salts. The water, however, was of fair quality.

On the following morning I examined the two smaller springs that are situated north of the Beresford or Trig. Hill, and found the waters much similar in taste to those of the Warburton, or chief spring of the group. From the height the travertine has attained around these springs, and the comparative smallness of the volume of water issuing therefrom, it appears to me that at some former period in their history these two springs were the main outlet to the water which now flows from the chief spring in large volumes. The travertine around the lesser springs is about fifty feet in height, and the reason why their waters have now become languid in their outflow may be on account of the greater distance they have to rise before reaching the surface, whilst the greater outflow of water at present from the much lower situated spring, south of the Beresford Hill, may arise simply from the difference of level at their exit.

The most interesting section of the secondary strata I met with in my travels in the north was obtained in connection with the Beresford Hill, but for various reasons it did not get the thorough inspection from me it otherwise should have got. From the imperfect view I obtained of it I saw that the beds constituting the upper portion of the hill, though seemingly perfectly horizontal, were much harder in texture than those forming the lower parts.

The Strangways Springs are a remarkable group, amounting in all, I was told, to about 400. I observed whilst some had a considerable volume of water, others seemed to have about attained their maximum height of travertine, and consequently discharged their waters more slowly; while others, again, seemed to be completely choked up through the accumulations of travertine that had collected around their outlets. The travertines from these waters consist chiefly of carbonate of lime, a little soda, and sulphurous matter, and in many cases a considerable percentage of ferruginous matter. I also observed, in several cases, that these mounds of travertine have been apparently acted upon by internal forces. Mr. Warren, sen., of Springfield, informs me that not unfrequently strange sounds have been heard about the Strangways, as if the pent-up gases in the water below were escaping upwards and exploding on reaching the surface, and he attributes to this cause the present shattered-like appearance many of the mounds present. In support of this theory he stated that one night a peculiar rumbling sound was heard in the neighbourhood of Finniss Springs, and on the following morning water was found to be

issuing from a place it had never been known to issue from before, and is still continuing to do so.

On leaving Strangways Springs we crossed the Warrenei Creek, and for miles afterwards there is nothing seen but a country bestudded with sandhills and claypans alternately—the latter being the bared portions of the secondary strata, the former the reconstruction of the desert sandstone, the prevailing winds having so arranged the sandy materials resting on the impervious clays of the secondary era into the features of sandhill and claypan, which may be said to culminate at the Yellow Waterhole Lake. This lake or waterhole is exceedingly uniform in depth throughout, and cannot contain a less area than sixty acres. Its entire surface is covered with a species of water-grass, which stands from four to five feet in height. This grass was nearly ripe at the time we were there, and the horses seemed exceedingly fond of it. Although fresh, the waters of the lake were thick with clayey and other matter in suspension. The sand-dunes, which must on an average stand about twenty feet high (contrary to natural order), seem to encircle this lake. For a considerable distance from the lake we travelled over a very similar country to that we had passed over the day before. At length we emerged upon an open plain, and the fossiliferous nodules, which we had not seen for some time, began to occur again.

Pursuing our course along the plain we arrived at the Emily Spring. A salt swamp intervenes between this spring and the William Spring, the two being situated about a mile apart—the former on the southern side of the incrusted claypan, and the latter on the northern. Neither of these springs have mounds rising more than three feet above the level of the surrounding plain, and from appearances are not likely ever to attain a much greater height. The water from the Emily Spring, though not abundant, is very fair in quality.

Next morning I visited the borehole on Anna Creek, the road being over sandhill country a considerable part of the distance. The country about the borehole, and for a considerable distance towards the Emily and William Springs, is evidently covered with the waste of the desert sandstone, as the well-sinkings immediately north of this place fully prove. Mr. John Hogarth, of the station, informs me that the kitchen well was the first he sank in this group, and that the first eighteen feet was through sand and clay, at which depth salt water was obtained. At a depth of thirty feet from the surface the blue clays of the secondary period were struck. At a total depth of seventy feet from the surface a plentiful supply of very fair household water was obtained, which rises in the shaft to within fifteen feet of the surface. During the shearing

season the draw upon this well cannot be less than 4,000 gallons daily, and that amount never lowers the water in the shaft more than about four feet.

About half a mile down the creek, and from ten to fourteen feet below the level of the kitchen well, the boreholes of the wool-washing establishments are situated. These two boreholes yield almost an unlimited supply of rather better water than the kitchen well does. In both cases the superficial spring of salt water was struck at a depth of from ten to fourteen feet from the surface, which was dammed back in the usual way by inserting piping in the borehole. One of these boreholes is only seventy-five feet in depth. The other, though yielding a large flow of water, was continued to a depth of 160 feet, in hope of increasing the supply, but in both cases the water rises to within eighteen inches or two feet of the surface. The deeper one yields a little more than the other, but the slight increase bears no proportion to the extra depth.

The blue secondary clays, which underlie a covering of sand from 20 to 30 feet in thickness at the borehole, occupy the surface of the country a mile or so before reaching the creek about six miles north of the William Spring. How far this formation extends from the boreholes in a north-westerly direction beneath the sandhills it is impossible at present to say. This much, however, with confidence may be said, that these clays stretch all the way beneath the sandhills across the country from the boreholes past the William and Emily Springs southward as far as Warrenei Creek near the Strangways Springs. Their north-westerly limits cannot, however, extend further than the site of the Moorumbuma Well, for in that sinking they are not represented, neither are they in the well at Anna Creek Head Station.

I also visited the flat, some nine miles distant, in which the Moorumbuma Well is situated. In this well the desert sandstone is the water-bearing stratum. The beds penetrated in this sinking are as follows:—A surface stratum of sandy clay. Beneath this clay the desert sandstone occurs, in which water was obtained at a depth of 63 feet, and at a total depth from the surface of 82 feet a copious supply of excellent stock water was obtained. It is possible that the blue clays at the secondary era may underlie the desert sandstone at this spot, but I scarcely think so, on account of the great thickness of the formation and the plenteous supply of water it produces. This well and all others whose waters are obtained in the desert sandstone seem never to rise in the shaft above the level at which they are first obtained. This peculiarity leads me to infer that waters with this feature are all of local origin.

After crossing Moorumbuma flat we ascended a large sand-

hill, from the top of which we could see the head station, situated on a gentle rise about half a mile before us, at which place we had not well arrived when rain began to fall, and though about quarter of an inch fell during the night, by 8 o'clock next morning scarcely a vestige of it was to be seen upon the surface.

For a distance of about two and a-half miles up from the head station on either side of Anna Creek the country continues to be of a sandhill character. To the south-west and west of Milcheterrana Hill it is studded over with gentle rises belonging to the Primary series. To the east of that hill, however, and for about a mile south-east on the eastern side of the creek a sandy plain stretches away for several miles in that direction. This plain is also here and there interrupted with bluffs of old rocks. Close to the creek and about three miles above the head station there is a band of very hard quartzite standing about eight feet above the level of the present surface; strike, 10° west of north; dip, about 10° easterly; thickness, about 16 feet. Fundamental slate rock also appears at the surface in *situ* at this place on the eastern side of the quartzite. The band, which here rises above the plain as a mere bluff, on pursuing its course northward constitutes the summit of Milcheterrana Hill. Directing our path a little more west from here, and at a distance of about a quarter of a mile, a band of blue marble was observed, which makes (as Mr. Hogarth informs me) most excellent mortar. Strike of this marble band, which is exposed at the surface for at least one hundred yards north, is about magnetic north and south, dip 60° east. The quartzite band, referred to above, constitutes the summit of the hill, from 130 to 140 yards to the east of the marble one. Between it and the quartzite, however, about one-third of the distance is occupied with marbles much more argillaceous in quality. On the western side of the pure marble band, which at this place is not more than two feet in thickness, a band of gritty quartzite is interbedded, the strike and dip of which are the same as that of the marble band.

The Anna Creek head-station and well are situated in lat. 28° 60′ south, long. 136° 8′ east. The well yields an inexhaustible supply of most excellent water. The strata penetrated consist, in descending order, of twenty-five feet of sandy clay, thirty-eight feet of desert sandstone, at which depth water was struck. The sinking was continued four feet further, making a total depth of sixty-seven feet. The stratum in which water was first discovered consisted chiefly of a gypsiferous clay. The daily quantity of water which the well produces has never been fully ascertained, but taking from it at the rate of 1,000 gallons an hour lowers the water in the shaft

one foot, but beyond that depth, although the quantity extracted be greatly increased, no further impression can be made upon the supply.

Tom's Well, which is also in the desert sandstone, is situated on a flat among sandhills about ten miles in a southerly direction from the head-station. The section of strata passed through in descending order was twenty-three feet through sand and clay, forty feet of desert sandstone, at which depth water was obtained. A thin bed of ferruginous conglomerate was afterwards pierced, from which the greatest amount of water flowed. This water, though of fair quality for stock, is rather salt for domestic purposes.

The Deep Well is situated about five miles from the preceding one, on a flat among sandhills about twelve miles south of the head-station, and about five miles distant in a north-westerly direction from Tom's Well. This well penetrates the desert sandstone 125 feet; its waters are much the saltest of any I have tasted in these parts of the north. A nodule of galena was taken from the sandstone beds whilst the well was in process of sinking. A borehole in progress some five to six miles above the William Spring was visited, and some of the clay which I secured from this sinking has been examined by Mr. Howchin, F.G.S., and has yielded some very interesting microscopic forms, particulars of which I append to this paper. Near this place I saw the spot where the fossil wood brought down by me had been taken from. I also satisfied myself on this occasion that the secondary strata, though obscured in the greater part of the distance with sandhills, are continued beneath them uninterruptedly from the borehole to William Creek.

My next geological tour was north as far as Mount Margaret. From the head station the first three or four miles of the journey the surface of the country consists either of loose sand or old rocks. In the middle of the plain—about four miles from the head station—the latter appear on the surface as a quartzite. The strike of these beds is about north and south; dip, east. These quartzites constitute a slight rise for a considerable distance north, and in one place showed in a hill of much greater size. On the southern slopes of this nameless hill the William Creek takes its rise in primary strata, but the mesozoic strata put on long before the creek reaches so far south as the William Spring. It would appear that the desert sandstone is continued as far east as this hill, for about four miles south-south-west from it water was found in a well penetrating that rock. From the summit of the hill just referred to we gradually descended to the Douglass, passing chiefly over sandy country. Before we reached the bed of the stream we came upon a patch of rock, overlying the old beds,

which closely resembles the Upland Miocene arenaceous beds of Munno Para East and the surrounding neighbourhood.

The Douglass Well, which is sunk in fundamental rocks, only yields about 1,000 gallons of water daily; it is about 60 feet in depth to the water-line, of which about fifteen feet is surface material, the remainder passing through old slate rock. At this depth a scanty supply of excellent fresh water was struck, which was slightly increased by sinking about ten feet further. At a total depth of 70 feet a bed of very hard and dry slate was struck. Driving was then resorted to in the hope of finding a better supply, but that, too, failed, and the enterprise was abandoned. Following the dry channel which runs nearly in a south-east by east direction from the well, I came to a bold bluff of very hard quartzite projecting about 20 feet above the general level of the country. The strike of this bed is 20° east of north; dip, 25° easterly. Looking down the dry channel into the Douglass gorge and at about three-quarters of a mile distant from this place, on the north-north-east side of the channel, another and a more prominent bluff of quartzite was displayed. As near as could be ascertained the strike of the beds is 10° west of north; dip, 45° easterly; height above the general level of the plain, about 50 feet. For a considerable distance up the stream, on the north-eastern side, seemingly nothing but felspar is exposed to view.

The track we then followed led in a north-north-easterly direction, and over country showing primary rocks. Nothing, however, of a very striking nature was observed, unless it was the occurrence of a patch or two of arenaceous beds similar to those we discovered on the western side of the Douglass. On reaching the Blackfellows' Quarry, which is between three and four miles from where we started in the morning, I noticed that the stone exposed to view is a gritty fissile quartzite, and must have been worked by the aborigines from time immemorial, judging from the size of the excavation, which extends along the strike of the beds a distance of from fifty to sixty yards, the depth of which in several places is not less than from ten to twelve feet. The strike of these beds is 10° south of east, dip 45° northerly. From the quarry referred to the country declines for about a mile and a half into the bed of Sunny Creek, after which a gentle rise occurs, when suddenly the surface aspect of the country is changed from that of a sandy nature to one literally covered over with ferro-arenaceous boulders and nodules of every fanciful shape and form. This character of surface is maintained for a distance of from half to three-quarters of a mile, when the track rapidly begins to fall to the level of the plain below. Yet the potstones and catheads of ferro-arenaceous material are scat-

tered over the surface as profusely as ever, and continue to be so until the bottom of the declivity is reached, which cannot be less than forty feet below the level of the upper plain. Afterwards a stratum of loose sand, varying in depth, takes the place of these ferro-arenaceous nodules all the way to the crossing at Davenport Creek. On the south-western side we examined a hill which was one of the many remnants of an extensive bed of Desert Sandstone, which at some former period had been deposited against the old rocks that lie to the south-west. We afterwards found the same formation had at one time overlapped the secondary strata to the north-east. From the uneven manner in which decay seems to be acting upon the formation, and the peculiar structure its bedding presents, there can be little doubt that the formation was of eolian origin, and that the deposits, of which these stacks now form but small and isolated remnants, were originally formed by being blown by the winds against the sheltered and upstanding edges of the primitive rocks.

About half a mile before reaching the crossing at Davenport Creek we observed a conical hill of old rocks situated on the eastern side, and at a distance of from 400 to 500 yards from the track, which cannot be less than 50 feet above the level of the surrounding plain.

On arriving at the bed of the creek we found by recent flood-marks that this creek when flooded carries quite as much water, if not more, than the Douglass. We also observed that the gumtrees are more numerous along its margins, and although somewhat stunted and gnarled in appearance they are also much taller than at the Douglass. Mulga and other lesser shrubs seem to thrive tolerably well on the flats around its banks. Crossing the Davenport Creek we soon found ourselves treading again on the blue clays of the secondary era, which here overlie for several miles to the west the rocks of primitive age, forming, as it were, the inside half of a rude parallelogram against the old rocks of the Mount Margaret Range on the west and those of the Douglass and Blackfellows' Quarry country on the south.

The rocks constituting the eastern side of Mount Margaret Range have a strike of about 30° west of north, and the trend of the range itself is nearly north and south. After crossing Hope Creek and approaching nearer the range we began distinctly to observe the outcrop of the harder beds as they showed in bold relief along the mountain side, presenting a most magnificent aspect under the rays of a declining sun. On arrival at the spring at the cattle yard we found the streams from the detached hills to the west had cut a gorge through the eastern side of the range immediately south of the spring,

extending for quite a mile across the mesozoic deposits. This channel is about ten feet deep near the junction of the old and new beds, and therefore I fully expected to find fossils of some kind or other, but so far as I could discover the beds were non-fossiliferous. From the top of the nearest peak we obtained a very fine view of the detached hills constituting the western part of the range, and also of the vast plain stretching easterly. As far as the eye could reach to the west nothing but hill beyond hill was to be seen presenting their weathered and shivered peaks to the setting sun; whilst to the east the view before us was a vast plain of unusual sterility, composed of secondary strata. The strike of the primitive rocks was found to be 30° west of south and east of north; dip, 65° westerly; estimated height above the level of the eastern plain, about 200 feet. The spring, which by no means can be called a strong one, wells out at the junction of a band of marble or primitive limestone, where the old beds join the new. A considerable amount of calcareous material (travertine) has been deposited around the spring at a former period. The water, though slightly tainted with mineral ingredients, is, nevertheless, very good drinking water.

I ascended another of the eastern peaks of the Mount Margaret Range, which stands about 25 feet higher, and situated about half a mile north of the one we had previously ascended. From the difference between the trend of the range and the strike of the strata the material of which this peak is composed is entirely covered with secondary beds ere they reach so far south as the spring, and I also observed that the rocks were becoming more gritty in character. I ascended another peak situated about a quarter of a mile further north, and found it composed of rocks still more gritty and harder than the summit I had left. From the top of this peak an excellent view of the surrounding country was obtained, and the bearings I found much similar to those we had taken the previous night. Following up the creek in the neighbourhood I came upon a stratum of the prevailing quartzite, metamorphosed so highly as to present the appearance of a quartz rock.

Analyses of Samples of Water.

Several samples of water taken from the springs mentioned in this paper were submitted for analysis to Mr. A. Thomas, F.C.S., analytical chemist, with the following results. All the wells referred to except one (Mount Margaret Spring) are situated on Messrs. Hogarth & Warren's run:—

Deep Well.

Solids per Imperial gallon, 10·60 grains, consisting of—

Sodium chloride	8·10
Sulphuric acid	1·03
Iron and alumina	·05
Lime	·89
Magnesia	·44
	10·51

Mount Margaret Spring.

Solids per Imperial gallon, 2·06 grains, consisting of—

Sodium chloride	1·24
Sulphuric acid	·34
Iron and alumina	·03
Lime	·52
Magnesia	·36
	2·19

Douglass Well.

Solids per Imperial gallon, 0·80 grains, consisting of—

Sodium chloride	·40
Sulphuric acid	·12
Iron and alumina	·08
Lime	·08
Magnesia	·06
	0·74

Wool-wash Borehole.

Solids per Imperial gallon, 5·00 grains, consisting of—

Sodium chloride	4·12
Sulphuric acid	·39
Iron and alumina	·02
Lime	·32
Magnesia	·29
	5·14

Kitchen Bore Hole.

Solids per Imperial gallon, 5·70 grains, consisting of—

Sodium chloride	4·12
Sulphuric acid	·20
Iron and alumina	·04
Lime	·70
Magnesia	·14
	5·50

Anna Creek Well.

Solids per Imperial gallon, 0·54 grains, consisting of—

Sodium chloride	0·20
Sulphuric acid	·17
Iron, clay, and magnesia	·10
	0.47

Tom's Well.

Solids per Imperial gallon, 10·70 grains, consisting of—

Sodium chloride	1·56
Sulphuric acid	1·03
Iron and alumina	·10
Lime	5·24
Magnesia	2·56
	10·49

PALÆONTOLOGY.

LIST OF FOSSIL MOLLUSCA collected by Mr. Scoular at Davenport and Humphrey Springs, Central Australia, determined by Prof. R. Tate:—

Belemnites australis, *Phillips (?)*. Fragments only.
Monotis Barklyi, *Moore*.
Modiola linguloides, *Huddleston*.
Modiola Scoulari, spec. nov. An ovately reniform shell similar to M. imbricata, *Sowerby*, of the English Jurassic rocks, but a little less curved ventrally and with strong corrugations in the umbonal region; length 65, breadth 32 millimetres.
Modiola sp. A cast only. Lanceolate with much produced anterior side.
Trigonia sp. Casts only. A trigonal form, a little longer than broad; certainly neither T. mesembria, *T. Woods*, nor T. nasuta, *Etheridge*.
Arcomya sp. Cast.
Pleuromya sp. Cast.
Cytherea (?) Clarkei, *Moore*.
Cypricardia sp. Cast.

LIST OF FOSSIL MICROZOA.—A small quantity of material from William Well, Lake Eyre district, was subjected to microscopical examination by Mr. Walter Howchin, who has supplied the following particulars:—

The Microzoa consist chiefly of Foraminifera, of which five species were noticed, viz.—

1. Cristellaria gibba, *d'Orbigny*.
2. Marginulina glabra, *d'Orbigny*.
3. Vaginulina legumen, *Linné*.
4. Nodosaria radicula, *Linné*.
5. Haplophagmium sp. (a single example much distorted).

All the above are known as fossil forms in British Palæontology. No 1 dates from Cretaceous times, No. 2 from the Lias, No. 3 from the Trias, and No. 4 from the Permian.

The geological material resembles that passed through in the Hergott borings, and all the foraminifera noted above were obtained in the Hergott material. There is therefore little doubt that Mr. Scoular's gatherings belong to the same geological formation.

The fossils other than foraminifera observed in the material under notice were a single carapace of an Entomostracan and some fragments of vegetable tissue. A few minute pyritous casts also indicate the existence of vegetable life.

Cuscuta Tasmanica. Murray River.

GEOLOGICAL SKETCH MAP OF LAKE EYRE BASIN.

SURVEYOR GENERAL'S OFFICE ADELAIDE

Additions to the Extra-Tropical Flora of South Australia.

By Baron F. von Mueller, K.C.M.G., F.R.S. &c.

[Read September 7, 1886.]

Capparis spinosa. Near the Finke River. *Lieut. Dittrich.*
Tribulus macrocarpus. Near Charlotte Waters. *Rev. H. Kempe.*
Sida platycalyx. Near Charlotte Waters. *Rev. H. Kempe.*
Phyllanthus thesioides. Near Charlotte Waters. *Rev. H. Kempe.*
Casuarina humilis. Eucla. *Bate.*
Portulaca australis. Near Finke River. *Lieut. Dittrich.*
Dodonæa tenuifolia. Near Spencer Gulf. *Prof. Tate.*
Gomphrena Brownii. Finke River. *Kempe.*
Bassia Cornishiana. Near the Queensland Boundary. *Cornish.*
Pultenæa scabra. Kangaroo Island. *Tepper.*
Crotalaria Mitchelli. Spencer Gulf. *Prof. Tate.*
Ptychosema trifoliolatum. Near McDonnell Range. *Kempe.*
Neptunia monosperma. Near McDonnell Range.
Acacia stipuligera. Near McDonnell Ranges. *Giles.*
Acacia Spilleriana, *J. E. Brown.* Wirrabara, Clare &c. *Brown.*
Acacia Whanii. Near the Murray River.
Acacia gonophylla. Near Eucla. *Bate.*
Acacia iteaphylla. Spencer Gulf. *F. v. M.*
Rotala diandra. Near MacDonnell Ranges. *Dittrich.*
Melaleuca quadrifaria. Near Eucla. *Bate.*
Eucalyptus Oldfieldii, *F. v. M.* McDonnell Range. *Schwarz.*
Hydrocotyle pterocarpa. Near Glenelg River. *Mrs. Dr. Wehl.*
Actinotus Schwarzii, *F. v. M.* McDonnell Range. *Schwarz.*
Spermacoce marginata. Near the Queensland Boundary. *Cornish.*
Pluchea tetranthera. Near McDonnell Range. *Kempe.*
Gnaphalium Indicum. Finke River. *Kempe.*
Calogyne Berardiana. Near Charlotte Waters. *Kempe.*
Goodenia Strangfordii. Near McDonnell Range. *Kempe.*
Cuscuta Tasmanica. Murray River.

Peplidium humifusum. Near Charlotte Waters. *Kempe.*
Utricularia lateriflora. Near Glenelg River. *F. v. M.*
Eremophila denticulata. Near Eucla. *Bate.*
Acianthus caudatus. Kangaroo Island. *Tepper.*
Crinum angustifolium. Near McDonnell Range.
Triodia Mitchelli. Near McDonnell Range.
Nitella microphylla, *Al. Braun*—named by Dr. Nordstedt. Onkaparinga River. *Tepper.*
Cladophora crispata. St. Vincent Gulf. *Tepper.*
Physcomitrium repens, *C. Mueller.* Spencer Gulf.

Description of a New Corchorus from Central Australia.

By Baron von Mueller, K.C.M.G., M. & Ph.D., F.R.S.

[Read September 7, 1886.]

Corchorus Elderi.

Somewhat shrubby, upright, much branched, thinly starry-tomentose; leaves small, almost oblong, or some merging into an ovate form, crenate-serrulated, above soon glabrescent; flowers minute; peduncles usually very short or obliterated; pedicels one—three, soon longer than the flowers, scantily star-hairy; calyx while unexpanded nearly globular; petals hardly exceeding the calyx; stamens twenty or fewer; style extremely short; fruit small, ovate-globular, four—five-valved, outside densely setular-and starry-tomentose; seeds five—three or rarely two—one in each cell.

In the region north of MacDonnell Range, found by Lieut. Dittrich during Mr. Lindsay's expedition.

Habit not unlike that of *C. hirsutus;* height, one—two feet; leaves short-stalked, half—one inch long, somewhat crisped; stipules and bracts wiry, short, setaceous-linear; peduncles occasionally lengthening to half an inch; flowers only one-sixth or one-fifth inch long; calyx deciduous, slit in its upper

part only, unless finally deeper; petals pale-yellow, glabrous, orbicular-ovate, not distinctly gland-bearing, though slightly thickened at the base; anthers cordate- or globular-ovate; style glabrous; fruit-bearing pedicels one-third to half-inch long; torus extremely short; disc spreading, membranous, undulating, glabrous; well-developed fruits one-third inch long, but not rarely smaller and also then maturing; its vestiture greyish and remarkably dense, consisting of star-hairy minute setules; valves inside glabrous and shining; septum of each valve straight and firm; descendingly tranverse, slight elevations between the seeds, but no distinct septules; seeds about one-twelfth inch long, oblique- or truncate-ellipsoid, smooth, brown-black outside and not shining.

This species is nearest allied to *C. sidoides*, but very different in its fruit, standing as regards the main characteristics of the latter quite alone; some affinity of our new plants to *C. echinatus* is also obvious, but that species is rendered by the septicidal dehiscence of its fruit-capsule somewhat anomalous in the genus *Corchorus* and verges much towards *Triumfetta*. Indeed, for limiting these two genera we can best rely on the structure of their fruits, and if from that the main distinctions are to be derived then *T. pilosa* among Australian species, as well as some African and other congeners, would need to be transferred from *Triumfetta* to *Corchorus*, as to some extent pointed out already in 1863 (Fragm. Phytogr. Austr. IV., 29).

In bestowing on so humble a plant the name of Sir Thomas Elder, I should remark, that this floral novelty is the most interesting gained during the expedition, which through the special aid of this munificent promoter of all interests of South Australia has been enabled to shed additional light also on the Central Australian flora.

Diagnosis of a New Species of Caladenia.

By Professor Ralph Tate, F.L.S., F.G.S., &c.

[Read October 5, 1886.]

Plate II.

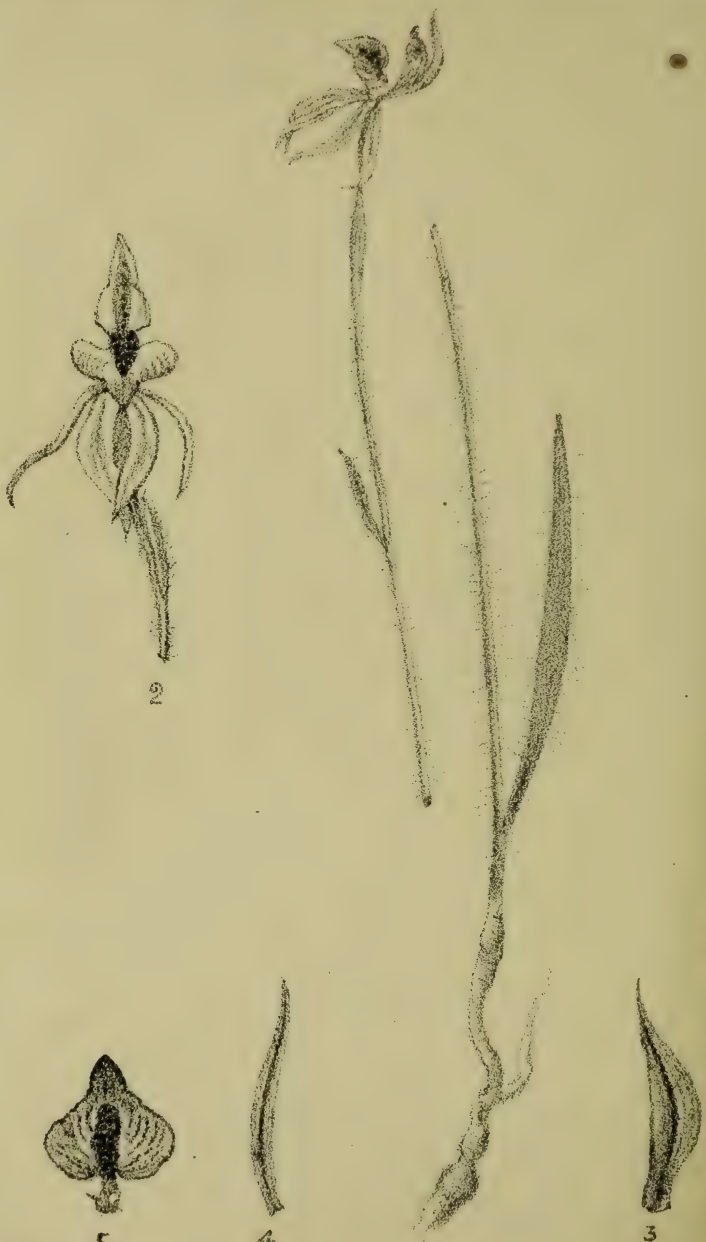
Caladenia cardiochila.

A slender hairy species from six to nine inches high; one-, rarely two-fld. Leaf linear lanceolate, sheathing at the base, from two to three inches long.

Sepals and petals brownish-red with a yellow margin, or yellowish with a brownish-red streak down the centre; linear-lanceolate, neither contracted nor clavate, and quite free of glandular pubescence. Dorsal sepal erect, incurved over the column; narrower than the lateral sepals, which are flat, lanceolate, dilated upwards, abruptly acuminate, and about 17 millimetres long by 4·5 broad. Petals linear, 17 millimetres long by two broad. Labellum on a long claw, undivided, margin entire, cordately ovate, somewhat flat, but not recurved, contracted towards the tip where the margin is thickened, and of a dark red-brown colour. The colour of the labellum is yellowish above and below, with a reddish margin, and streaked dichotomously on the upper side, and blotched on the wedge-shaped tip with the same colour. Length, ten millimetres; breadth, eleven mills. Calli in two rows, large, elevated, closely packed, oblong, attenuated at the base and graduating into linear-clavate at the base of the labellum, of a very dark red-brown colour. The anterior third of the labellum is naked. Column much curved, broadly winged in the upper two-thirds, mottled with brownish-red. Anther with a short acute point. Two oval calli at the base of the column.

Sandy ground under the shade of Casuarinas and Eucalypts, Golden Grove. Collected by various members of the Field Naturalists' Club, October 2, 1886. Barabba Scrub, Hundred Grace, S. Dixon (!), 1865.

This species is conspicuous amongst congeners associated with it by its broad labellum and short petals and sepals. The accompanying species were *C. dilatata*, R. Brown, *C. leptochila*, Fitzgerald, *C. carnea*, R. Br., and *C. latifolia*, R. Brown. From *C. dilatata* and its allies it is at once separable by its short sepal points, in which respect it approaches *C. Cairnsiana*, F. v. M. Its nearest ally is *C. tessellata*, Fitzgerald,



W.J.CHIDLEY DEL

agreeing with it in its short non-clavate sepals and petals, and its flattish labellum, from which it differs by the calli being in two rows, not continued to the point of the labellum, and by their shape, also by the simple margin to the labellum, and by its broadly ovate outline.

A few years ago Mr. R. Fitzgerald personally explored the neighbourhood of Adelaide in search of orchids, and with the result that six species previously undescribed were made scientifically known. Of these there are two Caladenias—*C. leptochila* and *C. reticulata*—both of which have sepals with long points, clavate, and glandular; and are therefore only distantly related to the species herein described. The former is easily recognisable by its narrow-oblong labellum; the latter, which externally resembles *C. dilatata*, has the labellum less deeply cut, and reticulated with raised veins (as in the section *Phlebochilus*, Benth., to which *C. Cairnsiana* belongs).

Explanation of Plate II.

1. Side view of the whole plant; nat. size.
2. Flower seen from the front; slightly enlarged.
3, Lateral sepal; 4, Petal; 5, Labellum. All enlarged two diameters.

Descriptions of some New Species of South Australian Marine and Fresh-water Mollusca.

By Professor Ralph Tate, F.L.S., F.G.S., &c.

[Read October 5, 1886.]

Plates IV. and V.

Helix reteporoides, *spec. nov.* Plate v., figs. 14 *a—c.*

Shell rather widely umbilicated, depressed, orbicular, thin; spire a little elevated; whorls five, convex, separated by a deeply-impressed or channelled suture; last whorl rounded, not descending in front, base convex; aperture slightly oblique to the vertical axis, subcircular; peristome simple, its margins disunited; columella slightly reflected over the umbilicus, which is wide and perspective. The ornament consists of regular, crowded, thin, elevated, equal ridges, and transverse, equidistant microscopic striæ in the intercostal furrows; the ridges are more distant on the spire whorls than on the last whorl; the transverse striæ are more conspicuous on the base, and the distance between them about equals the width of the interstitial grooves. Colour of shell reddish-brown.

Dimensions.—Major and minor diameters, 7 and 6·25; height, 4; diameter of umbilicus, 1·5 millimetres.

Localities.—Black Hill, near Adelaide, under rotten stumps of the "grass-tree"; under stones at the foot of the cliffs at the junction of the River Para and Jacobs' Creek; slopes of Kaiserstuhl, Barossa Range; in the stringybark forests about Clare and Penwortham.

This species belongs to a group of small shells, more or less depressed, and ornamented with raised lamellæ, represented by many species in Tasmania, with most of which I have compared it, and by three described species in South Australia, but two or more species yet remain undiagnostically known. As implied by the specific name, the shell above described has affinity with *H. retepora* (Cox), inhabiting the Flinders Range (*Masters*) and at *Port Lincoln* (*R. T.*); the general shape is the same, but in *H. reteporoides* the spire is not quite so elevated, the whorls more rotund, deeper suture, more convex base, larger umbilicus, the costal lamellæ equal and very much more numerous, and the transverse striæ finer.

Helix Tomsetti, *spec. nov.* Plate v., figs. 13*a*—*c*.

Shell conoidly depressed, rather thin, widely and deeply umbilicated; spire slightly elevated, widely conical, obtuse; whorls five, flatly convex, narrowly concavely depressed near the anterior suture, and margined at the suture; last whorl rounded, rather depressed above, and bluntly angled at the periphery; posterior to the angulation at the periphery the surface is slightly depressed, thence convex to the suture; base rather abruptly convex; aperture not descending in front, oblique to the vertical axis, rotundately lunate; peristome simple, thin, disunited; columella very slightly reflected over the umbilicus.

The ornamentation consists of coarse, irregular, oblique striations and distant granulations; the one and a half apical whorls granulose only; under surface striated. Colour of the living shell unknown.

Dimensions.—Major and minor diameters, 14·5 and 12·5; height, 7; height of aperture, 6; diameter of umbilicus, 2·5 millimetres.

Locality.—Cape Borda, Kangaroo Island, *(Tomsett!)*. This new species is somewhat intermediate between *H. Bordaensis* and *H. Evandaleana*, having more the shape of the former, but with the sculpture of the latter; it is flatter and has a larger umbilicus than *H. Evandaleana*.

Mitra pellucida, *spec. nov.* Plate iv., fig. 13.

Shell minute, slender, fusiform, translucent, colourless, polished; apex obtuse; whorls 6, flatly convex, suture distinct; the two or three apical whorls smooth, the rest with thick depressed axial costæ, the interstices linear and puncturated; last whorl lirate at the base; anterior portion of the columella slightly recurved; columella with three strong oblique plaits; outer lip not thickened, smooth within.

Dimensions.—Total length, 7·25; of aperture, 3·25; breadth of last whorl, two millimetres.

Localities.—In beach sand, Fowler and Streaky Bays in the Great Australian Bight.

This new species may perhaps belong to the section Mitroidea, it is certainly not the young of any known Mitridæ inhabiting South Australian waters, and I cannot attach it to any figured species of the family.

Paludina lirata, *spec. nov.* Plate iv., figs. 6*a*—*b*.

Shell subglobose, thick, imperforate; spire depressed, conic, obtuse, eroded at the apex; suture much impressed. Whorls four, convex, somewhat flattened posteriorly. Aperture oblique, large, semicircular; outer lip attenuated and acute; interior bluish-white; epidermis of an olive-green colour;

surface ornamented with longitudinal liræ and faint striæ, and obliquely transverse striæ and wrinkles of growth. There are six or seven prominent liræ on the penultimate whorl with a finer one occasionally interposed between them. On the last whorl the liræ in front of the periphery are less pronounced. Operculum horny, concentric, with the nucleus nearer the columella margin. The embryonic shells are diaphanous, pale-green, carinated on the periphery of the last whorl, on the posterior part of which are interstitial striæ between the liræ; the base is strongly striated; the nuclear whorls are depressed faintly striated longitudinally; there is no umbilicus.

The animal is oviviparous, so also is *P. sublineata*, *P. Hanleyi*, *Melania Tatei* and *M. Balonnensis*, giving birth to six to eight embryos of about three millimetres diameter.

Dimensions.—Total length, 18; greatest width, 18; height of aperture, 13; width of aperture, 10.

Locality.—Cooper's Creek at Innamincka, Central Australia, (*Mr. James McLeod!*).

The species is quite unique among Australian congeners.

Aspergillum multangulare, *spec. nov.* Plate iv., figs. 4*a*—*b*.

Disk roundly oblong, laterally sub-compressed, ventral and anterior sides prolonged into two rows of longish tubes; particles of coarse sand or shell are usually agglutinated to the disk, or it is adherent by one valve.

Valves oblong, inequilateral, translucent; umbones anterior, prominent; surface with distant concentric growth-folds, and rayed with microscopic lines.

Tube short, straight, or slightly bent, rather constricted at the proximal end; octagonal, obtuse, not keeled at the angles; transversely irregularly striate.

Dimensions.—Disk, antero-posterior diameter, 8; umbo-ventral, 5; sectional diameter, 3·5. *Tube*, length, 6; diameter, 3 millimetres.

Locality.—Not unfrequently cast up on the sandbeach of Holdfast Bay, St. Vincent Gulf.

This species belongs to the section of the genus corresponding with *Humphreyia* of Gray, which includes two other species only, both Australian; from those it differs conspicuously by its small size and many-angled tube.

Hemimactra versicolor, *spec. nov.* Plate iv., figs. 12*a*—*b*.

Shell cuneiformly ovate, solid, equivalve, very inequilateral, moderately convex; colour, white, yellowish, brown, purplish, bluish-white; shining, ornamented with rather fine growth ridges; umbos distinct, incurved, approximate; anterior side very short, its margin regularly rounded; posterior side produced, with a narrow dorsal area limited by an ill-defined um-

bonal ridge extending to the somewhat pointed post-ventral extremity; post-dorsal margin gently sloping for half its length, thence more abruptly descending to form an acute angle with the moderately convex ventral margin.

The right valve has the anterior lateral tooth thick and short, the posterior longer and less stout; the doubling of these laterals is but faintly exhibited; the cardinal tooth is small. In the left valve there are no traces of the superior and supplementary laterals.

Pallial line with a broad, very shallow, posterior emargination

Dimensions.—Antero-posterior diameter, 12·5; umbo-ventral diameter, 9·5; sectional diameter, 6 millimetres.

Locality.—Living in great abundance on the sandy bottom of Lake MacDonnell, Great Australian Bight. Lake MacDonnell is now entirely cut off from the ocean by lofty sanddunes; Zosteræ and other plants, as also several species of mollusca, still inhabit it.

The nearest ally of this pretty species is *M. cuneata*, Chem. It also bears some general resemblance to *Spisula fluviatilis*, Angas, but is more oblique and gibbous, not sharply angulated at the post-umbonal slope, and the dentition is very different.

Psammobia Brazieri, *spec. nov.* Plate v., fig. 1.

Shell elongate, somewhat donaciform, thin, shining, pellucid, slightly gaping at both ends, depressed; umbos small, acute, directed posteriorly, and situated far back.

The front dorsal margin is almost three times as long as the posterior, nearly horizontal and straight; the post-dorsal slope is very oblique and straightish. The ventral outline is but slightly curved, forming an obtuse rounded extremity anteriorly, and a blunt angle with the obliquely truncated posterior extremity. The posterior area is bounded by an acute umbonal carina, a little anterior to which on the interior is a thick ridge descending from the umbo and appearing on the exterior as an opaque white line.

Colour whitish, with a pink flame enclosed between the carina and the internal umbonal ridge. The sculpture consists of fine concentric lines of growth, becoming coarser on the posterior slope.

Dimensions.—Antero-posterior diameter, 12; length of posterior side, 3·5; umbonal ventral diameter, 6·5; sectional diameter of united valves, 2·25 millimetres.

Locality.—Aldinga Bay.

Tellina subdiluta, *spec. nov.* Plate iv., fig. 9.

Shell small, thin, semipellucid, white or pale yellow, shining; ornamented with close, regular, flat concentric ridges and linear interspaces; the ridges are slightly elevated, lamellar, fewer

and more distant on the posterior side. Elongate-oval, very inequilateral, a little convex; posteriorly narrow, rounded; anteriorly produced, acuminately rounded; post-dorsal slope very oblique, slightly concave behind the small acute umbo, thence a little ecurved to the rounded posterior margin; the antero-dorsal slope is very much longer, nearly straight. Right valve with two cardinal teeth, the posterior larger, triangular, and bifid; laterals well developed. Left valve with one bifid cardinal tooth only(?).

Dimensions. — Antero-posterior diameter, 9; umbo-ventral diameter, 5·5 millimetres.

Locality.—Dead shells from 22 fathoms in Encounter Bay.

This neat little species bears considerable resemblance to *T. diluta*, Smith, in Voy. Challenger, but is much shorter posteriorly, and otherwise a little different in outline, as also in sculpture.

Tellina Aldingensis, *spec. nov.* Plate v., fig. 2.

Right valve transversely elongate, subdepressed, much inequilateral; the anterior side larger than the posterior, rounded at the extremity and scarcely narrowed; posterior considerably attenuated, and narrowly truncated and inconspicuously biangulate at the extremity. The carination of the posterior slope is broadly and flatly convex, in front of which the shell is slightly depressed, but corresponding therewith on the interior there is a conspicuous, white, narrow ridge. Colour yellowish-white. The sculpture consists of linear striæ of growth, which are developed into slightly-raised laminæ on the posterior slope.

The sip honal inflection is very deep, reaching near to the anterior scar, narrowly rounded at the end, and confounded with the pallial line.

This species comes near to *T. imbellis*, Hanley.

Dimensions.—Antero-posterior diameter, 31; umbo-ventral diameter, 18; sectional diameter of right valve, 3; length of posterior side, 11·5 millimetres.

Locality.—Aldinga Bay.

Venerupis crebrelamellata, *spec. nov.* Plate iv., figs. 14*a*—*b*.

Shell oblong, somewhat elliptical, tumid about the umbones which are incurved, approximate, and anterior; anterior side attenuated; roundly truncated behind; concentrically closely exfoliated.

The anterior side is short, its dorsal margin straight, and very sloping, and forming with the abruptly ascending slope of the ventral margin a blunt angle; the post-dorsal side is slightly arched, descending to the narrow somewhat obliquely truncated posterior margin; the posterior part of the ventral

margin is nearly horizontal, thence rapidly ascending to the somewhat apiculate front extremity.

Sculpture.—On the umbonal region it consists of concentric ridges and raised radial lines; the interspaces between the ridges are concentrically striated and decussated by the radial lines. Proceeding outwards the ridges are gradually developed into thin, erect, crowded, crenately-wrinkled laminæ, which towards the posterior margin are broader and frilled; the radial lines of the umbonal area are continued as opaque pinkish-white thickenings in the crenatures on the dorsal face of the otherwise pellucid lamellæ.

Colour greyish, with a purplish or flesh-coloured stain about the umbones and posterior area.

The pallial line which is stained brown is near the margin; the sinus is narrow rather short and acute at the apex; the post adductor scar is purplish-brown and the anterior one pale-horn.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 14; sectional diameter, 13 millimetres.

Locality.—Burrowing in stiff clay on the north side of the mouth of the River Patawalonga, Holdfast Bay.

This species differs from all known species having lamellose ornament by its attenuated front and crowded lamellæ.

Corbicula desolata, *spec. nov.* Plate iv., figs, 11*a*—*b*.

Shell subtrigonally ovate, subequilateral, very convex with very prominent umbones; anterior side shorter, rounded at the margin, posterior margin more sharply curved.

Epidermis glossy, straw-coloured in young examples, brown in the adult. The ornament consists of distant, regular, acute, concentric ridges, passing into crowded raised lines on the posterior side where the epidermis is dull, darker in colour, and is crossed by fine oblique filaments.

Ligament short, brown. Interior of the valves bluish-white towards the margins, opaque-white towards the umbones. Hinge with three cardinal teeth in the right valve; the anterior one is small, the other two are grooved on their summits; the sockets for the lateral teeth are transversely striated. The left valve has two cardinal teeth, and the lateral teeth are transversely striated on both faces.

Dimensions.—Antero-posterior diameter, 17; umbo-ventral diameter, 15; sectional diameter, 11 millimetres.

Locality.—Cooper's Creek at Innamincka, Central Australia (*Mr. James McLeod!*).

C. desolata is related to *C. Angasi*, but differs by its more equilateral outline and great convexity,

Lucina crassilirata, *spec. nov.* Plate iv., fig. 2.

Shell orbicular, subglobose, very thick, regularly convex except in the post-dorsal area which is abruptly compressed. Surface

ornamented with thick concentric ridges, broader than the intervening concave sulci, and rather distant thickish threads which somewhat crenulate the margins of the liræ, but do not pass over them; inner margin of the valves strongly crenulated on the ventral region, minutely so on the front dorsal and posterior edges. Lunule small, shallow.

Dimensions.—Antero-posterior diameter, 8·5; umbo-ventral diameter, 8·25; sectional diameter, 7 millimetres.

Locality.—Shell sand, Streaky Bay.

This little species has a general resemblance to *L. columbella*, Lamarck, but has its closest ally in *L. nuciformis*, Tate, a fossil of the Older Tertiary beds of Aldinga Bay, from which it differs by being less gibbous, less angulated behind, and by its thicker liræ.

Lepton ovatum, *spec. nov.* Plate v., fig. 11.

Shell oval, thin, semitransparent, moderately convex, subinequilateral; umbos, blunt, approximate, projecting beyond the dorsal margin, slightly inclined to the front, situated a little behind the centre. Margins rounded on sides, except dorsally.

The sculpture consists of slight concentric striæ and microscopic granules. Owing to the transparency of the shell, the exterior exhibits the muscular scars and pallial line of the interior.

The right valve has one cardinal tooth, and the left valve two cardinal teeth, each with a lateral on each side, those of the right valve more remote.

Dimensions.—Antero-posterior diameter, 2; umbo-ventral diameter, 1·5; sectional diameter of closed valves, 1 millimetres.

Locality.—Shell sand, Holdfast Bay.

Kellia Angasiana, *spec. nov.* Plate v., fig. 7.

Triangularly oval, inequilateral, rather convex, extremely thin, dull, semitransparent. Dorsal margins sloping from the beaks towards each end, somewhat roundly truncate on the anterior side, roundly produced posteriorly, and the ventral margin moderately curved; umbo small, prominent, situated considerably in front of the centre.

The sculpture consists of numerous unequal elevated concentric threads.

Dimensions.—Antero-posterior diameter, 2·5; umbo-ventral diameter, 2; sectional diameter of both valves, 2 millimetres.

Locality.—Shell sand, Holdfast Bay.

Montacuta meridionalis, *spec. nov.* Plate v., fig. 4.

Ovately orbicular, sub-equilateral, somewhat gibbous, extremely thin, glossy, transparent, margins rounded; umbo

small, acute, hardly projecting beyond the dorsal margin, situated a little in front of the centre; posterior side the larger. The sculpture consists of fine concentric striæ.

Left valve with two diverging teeth, between which is the cartilage pit.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 8; sectional diameter of both valves, 4 millimetres.

Localities.—Shell sand, Aldinga Bay and Port Lincoln.

Scintilla (?) lunata, *spec. nov.* Plate iv., fig. 8.

Shell minute, approximately semicircular in outline, subequilateral, compressed, yellowish-white, dull, translucent; umbones small, though prominent, median, smooth. Surface of the valves concentrically faintly striated, and towards the margin minutely papillose, with a few larger papillæ grouped somewhat radially.

Dorsal line straight, the rest of the periphery almost uniformly arched, the posterior side being a little more attenuated than the anterior. Ventral gape wide, lanceolate. Ligament internal, bounded on each side in each valve by an obtuse tooth with a bifid crown and a long lateral. Margin of valves plain; interior nacreous, with the growth lines well shown.

Dimensions.—Greatest length of dorsal line, 7·25; greatest width, 3·5 millimetres.

Locality.—Creeping on rocks at extreme low tide at Edithburg, St. Vincent Gulf *(McDougall !)*

Cardita rosulenta, *spec. nov.* Plate v., fig. 3.

Shell trapezoidally ovate, transverse, moderately convex, inequilateral; umbones oblique incurved; anterior side short, obliquely and roundly truncated and flattened posteriorly; post-dorsal margin straight, slightly sloping; front-dorsal margin abruptly sloping and somewhat concave in front of the umbo. Lunule inconspicuous, broadly cordate, smooth. Surface ornamented with 22 very narrow subacute ribs, the anterior ones furnished with thickish annular scales, the middle and posterior ones with erect, arched, or subspinose scales; interspaces between the ribs concave, two or three times wider, concentrically, distantly, and irregularly striated.

Epidermis very thin, golden-yellow, minutely ciliate-fringed. Colour of shell whitish, the ribs pink and spotted with red; interior white, flesh-coloured from the umbo to the post-adductor scar.

Dimensions.—Antero-posterior diameter, 21; umbo-ventral diameter, 17; sectional diameter, 13 millimetres. Proportion 100 : 81 : 63.

Localities.—Small dead shells dredged in 22 fathoms, Encounter Bay, and in 32 fathoms, Backstairs Passage, and cast

up in Streaky and Fowler's Bays. Large living examples cast up at Rosetta Head, Encounter Bay (*R. H. Pulleine!*).

This new species has much the shape of *C. Preissii*, Menke, as figured by Reeve, from which it differs by being wider behind, with a well-defined posterior slope, and more convex; whilst the ribs are narrow, elevated, and more numerous. The proportion of the measurements of *C. Preissii* corresponding with those given above for *C. rosulenta* is 100 : 75 : 50. *C. rosulenta* makes a near approach to *C. scabrosa*, mihi, of the Old Tertiary of South Australia and Victoria, but has fewer ribs, and has not the arched dorsal line of that species.

Cardita obliquissima, *spec. nov.* Plate v., fig. 9.

Shell minute, very oblique and inequilateral, thick, white or pale rose colour. Anterior side much larger than the posterior, produced in front, pyriform; posterior side very narrow, abruptly sloping from an angulation extending from the umbo to the post-ventral margin; the whole surface is sculptured with distant, regular, somewhat wavy concentric grooves, and the posterior slope is ornamented with four or five radial riblets.

The hinge consists of a single thick, broad, triangular tooth in the right valve, which fits in between two more slender divergent teeth in the left.

Margins coarsely crenulated.

Dimensions.—Antero-posterior diameter, 3·75; umbo-ventral diameter, 3·25; sectional diameter through both valves, 2 millimetres.

Locality.—In shell sand at a depth of 22 fathoms, Encounter Bay.

Carditella subtrigona, *spec. nov.* Plate iv., fig. 10.

Shell triangularly ovate, somewhat solid, inequilateral, rather compressed, thick; umbones prominent, inclined forward, and considerably in advance of the centre. Surface ornamented with fourteen radiating costæ, which are covered with closely arranged, thick, compressed nodules; the interspaces are deep, a little narrower than the ribs, and are concentrically lirate.

The front dorsal margin is slightly concave in front of the umbo, thence rapidly sloping to the rounded anterior margin; the post-dorsal margin is ecurved, not so sloping, and longer than the front dorsal margin. The posterior margin is roundly truncated, and the ventral one regularly arched.

The inner margin of the valves is strongly and squarely dentate.

The left valve has two divergent cardinal teeth, the posterior one of which is considerably longer than the other; the right valve has a strong broadly triangular central tooth. There is

a lateral tooth on each side in both valves; the anterior one in the left and the posterior one in the right valve is submarginal.

Dimensions.—Antero-posterior, 5; umbo-ventral, 4·25; and sectional diameters, 2·75 millimetres.

Locality.—Dead shells cast up in Streaky Bay, Great Australian Bight.

This species is like *C. pallida*, Smith, the type of the genus, with which it agrees by the number of nodular ribs, but it differs as from all known species by its inequilateral triangularly ovate outline.

The genus Carditella was established by Mr. E. A. Smith in 1881 (Proc. Zool. Soc., p. 42) for Cardita-like shells with well developed lateral teeth on each side. It now comprises nine species—three on the west coast of South America, four Australian, one Cape of Good Hope, and one off Tristan da Cunha.

Limopsis rubricata, *spec. nov.* Plate v., fig. 6.

Obliquely oval, inequilateral, inflated; umbo very prominent, antemedian. Hinge line straight, the anterior margin obliquely descending.

Colour whitish, with four radial flames of chestnut beneath a thin light horn-coloured epidermis. The sculpture consists of regular concentric striæ, and towards the front margin of inconspicuous radial threads.

Margin of the valves coarsely crenulated all round. Hinge line with prominent teeth—three in front and five behind.

Probably a young shell, but not referrable to any known species.

Dimensions.—Antero-posterior diameter, 2·75; umbo-ventral diameter, 3; sectional diameter of united valves, 1·75 millimetres.

Locality.—Dredged in life from 32 fathoms in Backstairs Passage.

Pinna inermis, *spec. nov.* Plate iv., fig. 5.

Young shells up to 100 millimetres long, triangular-elongate, thin, semitransparent, slightly convex, ornamented with distant depressed longitudinal ribs and imbricating lamellæ of growth.

Colour light-horn, with a yellowish-brown band along the dorsal margin posterior to the ligament, and longitudinal streaks of the same colour on the rest of the surface.

The dorsal margin is straight, apical angle about 35°; the ventral margin slightly concave about the byssal orifice, thence slightly ecurved, the posterior end is truncated, the post-dorsal angle being 90° or less, joining the ventral margin with a rapidly ascending curve.

Adult shell cuneiform, somewhat elliptical, elongate, rather thick, semitranslucent, of a dark-brown colour, greyish towards the posterior margins where the lamellæ are densely imbricating and exfoliating.

In the anterior-third the valves are rather acutely convex, becoming increasingly depressed posteriorly; the axis of elevation is nearer the dorsal margin, and consequently the dorsal slope is steeper and shorter than that on the ventral side, which is undulatory ridged for about one-half or one-third of the whole length from the apex; posterior to the byssal orifice the ridges are marginal.

The dorsal margin nearly straight, varying from slightly convex to slightly concave; the ventral margin usually concave about the byssal orifice, thence convex to about two-thirds its length, where it commences to curve downwards to join the posterior margin. The posterior margin arched, somewhat produced, corresponding with the axis of elevation of the valve.

Surface ornamented with imbricating adpressed lamellæ and slight growth folds, especially on the anterior-ventral and-dorsal slopes; some individuals exhibit faint longitudinal ribs on the dorsal slope. Interior bluish-brown.

Dimensions of a large specimen.—Greatest length from the apex, 280 millimetres (14¼ inches); dorso-ventral diameter at right angles to the axis at two-thirds the whole length from the apex, 153 millimetres (six inches); greatest sectional diameter of both valves at about half the axial length, 51 millimetres (two inches).

Localities.—Vertically imbedded by their apices in the soft bottom of sheltered bays, just below low-tide mark; general from Eucla to the South-East.

This common so-called "razor-fish" has hitherto been known as *P. Zeylanica*, which name was applied to it by Angas in 1865, on the supposition that it is identical with the N.Z. shell. This identification is obviously erroneous, and is altogether inexplicable, as the two species are so widely different. The true *P. Zeylanica* has longitudinal ribs armed with close short semicylindrical hollow spines, and has a truncated posterior margin.

T. Woods (Proc. Tas. for 1875, p. 161) has evidently been misled, for in his description of *P. Tasmanica* he says, that in the few irregularly much-raised tubular scales it is quite distinct from *P. Zeylanica*, which is not uncommon in Australia. This author would seem to have been unacquainted with that species inasmuch as the characters he relies on by which to separate it from the species herein named, *P. inermis*, are such as ally it to *P. Zeylanica*, and raises a doubt if it be distinct from it.

Pecten Bednalli, *spec. nov.* Plate iv., figs. 3*a*—3*b*.

Shell somewhat triangularly orbicular, slightly convex, rather thin, scarcely equilateral, equivalve; ornamented with about 24 bundles of two or three subequal ribs, and shagreen sculpture in the interspaces. Ears very unequal, radially ribbed Colour of left valve purplish, with dashes or blotches of white. Right valve white, varied with pale flesh colour.

Dimensions.—Antero-posterior diameter, 28; umbo-ventral diameter, 25; sectional diameter, 8 millimetres.

This species is like *P. asperrimus* in shape and auricles, though it is a little more attenuated dorsally, but differs in the arrangement of the ribs and in the shagreened surface, by which latter character it resembles *P. bifrons*. The ribs increase in number from the umbonal region to the front by repeated bi- and tri-furcations, and are at first very little raised and plain; but towards the margin are subangular, and crowned with small prickly serratures (not scales, as in *P. asperrimus*). The ribs of each group of two are usually equal in size, but when three are together the middle one is usually stouter. Occasionally a single slender rib is interposed towards the front between the bundles.

Locality.—Aldinga Bay (*Mr. W. T. Bednall!*)

Pecten Pulleineanus, *spec. nov.* Plate iv., figs. 1*a*—1*b*.

This species is allied to *P. asperrimus*, but less orbicular and flatter. The ribs are 33 in number, simple, subacute, crossed by close-set continuous lamellæ—not interrupted on the flanks and in the sulci as in *P. asperrimus*. Anterior ear of right valve very narrow, elongate, radially ribbed; posterior ear, as in *P. asperrimus*, six-rayed raised into lamellose scales.

Dimensions.—Antero-posterior diameter, 23; umbo-ventral diameter, 19·5 millimetres.

Locality.—South-East coast (*Mr. R. H. Pulleine*!)

Among other Australian species it makes some approach to *P. cruentatus* and *P. blandus*, Reeve, but is not likely to be confounded with them.

Limea austrina, *spec. nov.* Plate iv., fig. 7.

Shell subovate, almost equilateral, very convex, solid, ornamented, with about twenty radiating nodulose ribs; the intervening sulci are somewhat narrower than the ribs, and are crossed by distant thickish liræ; umbones prominent, incurved; the hinge margin, on each side of the sunken broadly triangular ligament pit, is transversely minutely denticulated.

The outer margin of the valves is bluntly dentate, and the interior is regularly grooved, the furrows corresponding with the external costæ.

Dimensions.—Antero-posterior, 6 ; umbo-ventral, 7 ; and sectional diameters, 4·5 millimetres.

Localities.—Dead shells dredged from 33 fms, Backstairs Passage, and from 22 fms, Encounter Bay (*Pulleine*!). Also in Pliocene beds, Limestone creek, W. Victoria (*J. Dennant*!).

This pretty species has the form and sculpture of *Limatula Torresiana* (E. A. Smith,), but has fewer ribs and coarser concentric ornament, and by the presence of teeth on the hinge is removed generically from it.

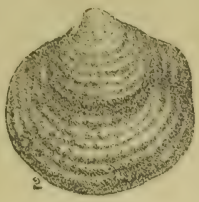
EXPLANATION OF PLATES.

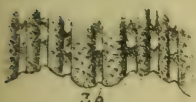
Plate IV.

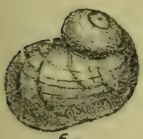
1. Pecten Pulleineanus, *Tate.* *a*, Right valve, nat. size ; *b*, magnified view of portion of surface near the front.
2. Lucina crassilirata, *Tate.* Right valve enlarged.
3. Pecten Bednalli, *Tate.* *a*, Right valve and apical part of left valve, nat. size ; *b*, magnified view of portion of surface at the front.
4. Aspergillum multangulare, *Tate.* *a*, Front view of the whole shell ; and *b*, section of tube at the end ; both enlarged.
5. Pinna inermis, *Tate.* Reduced from an example 18 inches long.
6. Paludina lirata, *Tate.* *a*, Back ; and *b*, front views ; nat. size.
7. Limea austrina, *Tate.* Much enlarged.
8. Scintilla lunata, *Tate.* Left valve, much enlarged.
9. Tellina subdiluta, *Tate.* Left valve, much enlarged.
10. Carditella subtrigona, *Tate.* Left valve, enlarged.
11. Corbicula desolata, *Tate.* *a*, Dorsal aspect ; and *b*, right valve ; nat. size.
12. Mactra versicolor, *Tate.* *a*, Dorsal aspect ; and *b*, left valve ; nat. size.
13. Mitra pellucida, *Tate.* Much enlarged.
14. Venerupis crebrelamellata, *Tate.* *a*, Left valve ; and *b*, dorsal aspect ; nat. size.

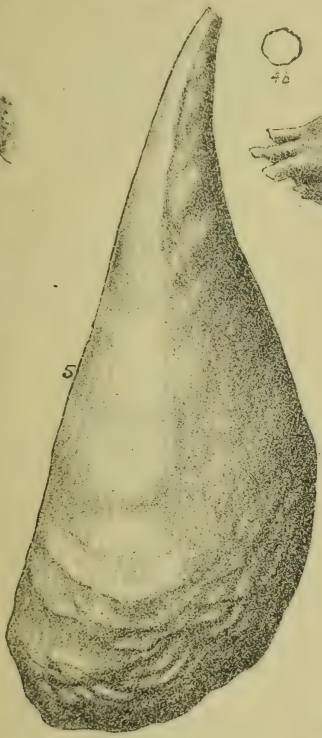
Plate V.

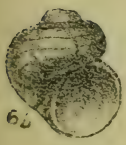
1. Psammobia Brazieri, *Tate.* Left valve, enlarged.
2. Tellina Aldingensis, *Tate.* Right valve, nat. size.
3. Cardita rosulenta, *Tate.* Right valve, nat. size.
4. Montacuta meridionalis, *Tate.* Left valve, much enlarged.
5. Semele exigua, *H. Adams.* Right valve, enlarged.
6. Limopsis rubricata, *Tate.* Right valve, much enlarged.
7. Kellia Angasiana, *Tate.* Left valve, much enlarged.
8. Semele Ada, *Adams & Angas.* Right valve, enlarged.
9. Cardita obliquissima, *Tate.* Left valve, much enlarged.

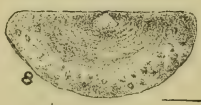


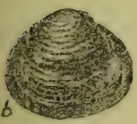


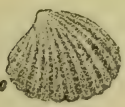


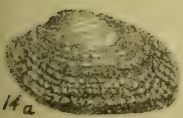


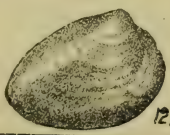




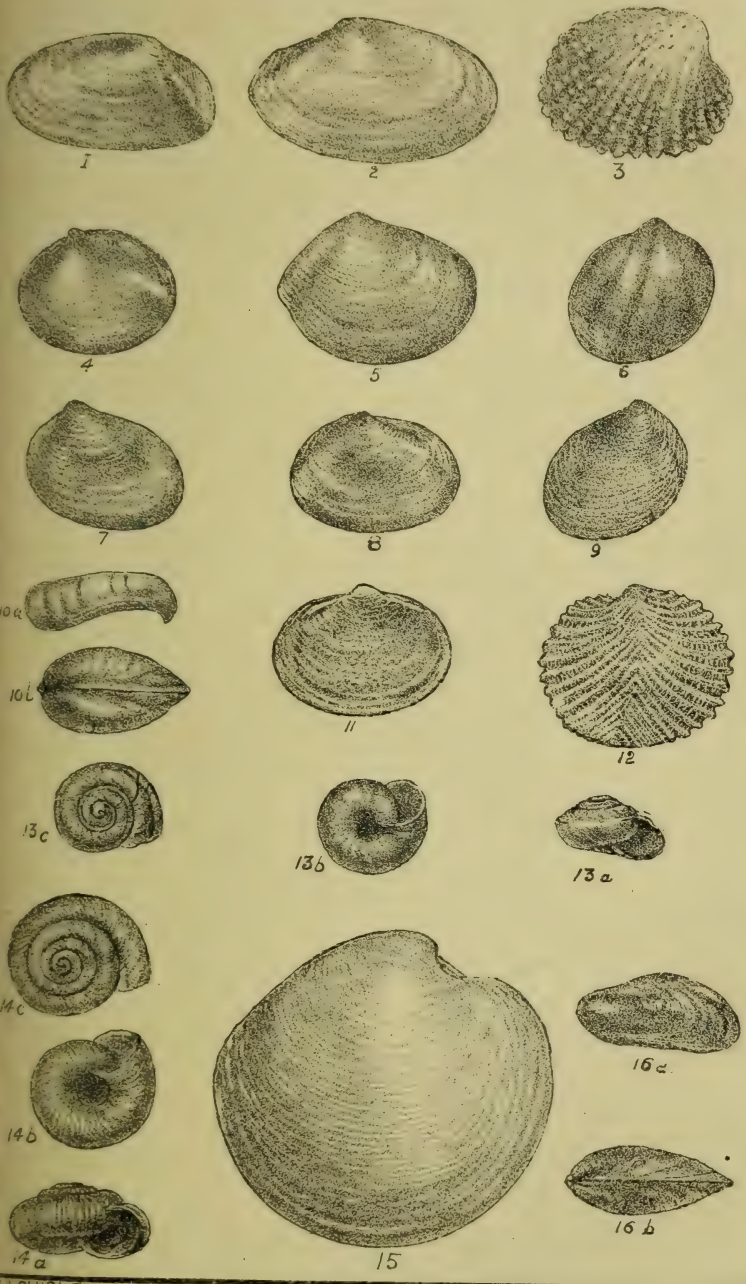








J.CHIDLEY DEL



W J CHIDLEY DEL

10. Gastrochæna Tasmanica, *T. Woods*. *a*, Right valve; and *b*, dorsal aspect of united valves; enlarged.
11. Lepton ovatum, *Tate*. Left valve, much enlarged.
12. Pythina Tasmanica, *Tenison Woods*. Left valve, enlarged.
13. Helix Tomsetti, *Tate*. *a*, Front view; *b*, basal aspect; and *c*, view from above; nat. size.
14. Helix reteporoides, *Tate*. *a*, Front view; *b*, basal aspect; and *c*, view from above; enlarged.
15. Dosinia grata, *Deshayes*. Right valve, nat. size.
16. Modiola semivestita, *Dunker*. *a*, Left valve, and *b*, dorsal aspect of united valves; nat. size.

A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Peron, the naturalist to Baudin's Expedition (1802-3), carried the first conchological collection from South Australian waters to Europe. From the narrative of the Expedition written by Peron we learn that gatherings were made at the archipelago of the St. Francis Isles and at Nepean Bay, Kangaroo Island. The collection as a whole remains unpublished up to the present day; but Lamarck made some selections from it, which were described in his "Animaux sans Vertebres," vols. 5 to 7, 1818-1822; they consist of eighteen species of lamellibranchs and two of gastropods, a list of which here follows:—

1. Crassatella sulcata. Kangaroo Island and Shark Bay, W.A.
2. Crassatella cuneata. Kangaroo Island.
   [= Mesodesma (Anapa) cuneata.]
3. Amphidesma glabrella. Kangaroo Island.
4. Saxicava australis. Kangaroo Island.
   [= S. arctica, *Lin.*]
5. Venerupis distans. St. Peter and St. Francis Isles.
   [= V. exotica.]
6. Psammotea candida. Kangaroo Island.
   [= Macoma candida.]
7. Tellina albinella. St. Peter and St. Francis Isles.
8. Tellina capsoides. St. Peter and St. Francis Isles.
9. Tellina deltoidalis. St. Peter and St. Francis Isles.
10. Donax epidermia. Kangaroo Island.
    [= D. deltoides.]
11. Donax deltoides. Kangaroo Island.
12. Donax cardioides. St. Peter and St. Francis Isles.
13. Venus conularis. St. Peter and St. Francis Isles.
    [= Chione aphrodina.]
14. Venus aphrodina. Kangaroo Island.
    [= Chione aphrodina.]
15. Cypricardia rostrata. Kangaroo Island.
16. Isocardia semisulcata. St. Peter and St. Francis Isles.

17. Arca avellana. St. Peter and St. Francis Isles.
18. Perna nucleus. St. Peter and St. Francis Isles.
19. Fasciolaria coronata. Kangaroo Island.
20. Buccinum fasciatum. St. Peter and St. Francis Isles.
[= Nassa fasciata.]

The number of the bivalves is reduced to sixteen by exclusion of names considered synonymic; the following are recognised as inhabiting our waters:—*Crassatella cuneata, Saxicava australis, Venerupis distans, Tellina albinella, T. capsoides, T. deltoidalis, Donax deltoides, D. cardioides, Venus aphrodina*; the remaining seven are either indeterminate species, or if defined species then not certainly known to occur in South Australia. That the names of localities have in some instances been misquoted is very certain. Of the six Lamarckian types of *Psammotea candida* in the Paris Museum, Von Bertin says that one is labelled from Timor, one from China, and four are without localities. Nevertheless, though we may cast a doubt as to the accuracy of the record of observation, yet we should hesitate to reject *in toto*; for eighty years *Donax cardioides* had remained unobserved in the region whence it was first obtained.

The late Mr. Cuming extended his collecting tour to our waters, and many new species then obtained by him have been described by Reeve, Sowerby, Adams, and other monographers. The Cumingian collection, on the death of its founder, was acquired by the British Museum.

As a result of several years' personal collecting in this province, Mr. G. F. Angas published in the Proceedings of the Zoological Society for 1865 a list of all the known species of marine mollusca known to inhabit South Australian waters; previously to the publication of which many new species were scientifically diagnosed by MM. Crosse and Fisher, himself, and others. This list contains the names of ninety-six species of Lamellibranchs and one Palliobranch.

Mr. W. T. Bednall, in a List of Species of our Marine Mollusca privately printed, added a few bivalves not previously recorded.

Through material communicated by me, Mr. G. F. Angas published in 1878 a first Supplement, and in the following year a second Supplement to the List of our Marine Mollusca. From these sources the total number of Lamellibranchs was brought up to 116, and the Palliobranchs to 2. Of the 116 names of bivalves 13 are considered synonymic, thereby reducing the number of species to 103; by recent accessions chiefly and by the recognition of a few Lamarckian species as endemic in the province, the total number of known species of Lamellibranchiata is 166, including 9 freshwater species, and of

Palliobranchiata, 5. The publication of a revised list of our bivalves has further been rendered desirable by reason of considerable changes in the nomenclature. Some of the alterations consist in the substitution of prior names, and a few of them are a consequence of more correct identification.

To render this list a partial aid to the determination of the species, I have added brief characters to each when considered necessary.

I have thought it superfluous to furnish all localities at which a common species occurs, and only in the case of rare species have localities and the collectors' names been given. The sign (!) following the collector's name indicates that I have examined specimens from the reported locality. In every instance I have exercised the utmost care in investigating the circumstances under which the species were obtained to the exclusion of all possible scources of accidental introduction.

The chief collections which I have had under examination are those of Mr. W. T. Bednall, embracing the coast-line from Port Lincoln to the South-east; Mr. Forwood, Holdfast Bay; Mr. Tepper, Ardrossan; Dr. Gosse, Wallaroo Bay; Mr. McDougall, Southern Yorke's Peninsula; Mr. Pulleine, St. Vincent Gulf and South-east coast; the South Australian Museum, St. Vincent Gulf. I have to acknowledge also my obligations to Mr. Brazier, of Sydney, for his assistance in the determinations of some critical species; by reason of his extensive conchological library and accurate knowledge of Australian species, a value is attached to his identifications, which few authors can attain to. Personal explorations during the past eleven years have embraced all the more important collecting stations from the mouth of the river Glenelg to Eucla.

Dredging operations have been undertaken only to a limited extent, being chiefly restricted to the shallow waters of the Port Adelaide creek and St. Vincent Gulf. A haul from 32 fathoms in Backstairs Passage brought to light a few species hitherto unknown to occur with us. Mr. Pulleine's dredgings in deep water off Encounter Bay, carried on during the early months of this year, have been more fruitful of results, and the oyster dredgings in the Port Lincoln District have furnished some little information. And though we may congratulate ourselves with an extensive acquaintance with the Molluscan life of the littoral and shallow water regions, yet we do anticipate a new revelation when the deeper parts of our oceanic waters shall have been explored.

The following list embraces all the species previously recorded under specific names different from those employed in the present work and such as are excluded or unrecognisable. In the first column are given the names hitherto used; in the

second the author of the record, and in the third the specific names herein adopted, or the reason for the exclusion of the species :—

Corbula nasuta [Sow.], *Angas.*	C. scaphoides, *Hinds.*
Saxicava australis, *Lamarck.* / Saxicava Angasi, *Adams.*	S. arctica, *Linn.*
Lutraria Philippinarum [Desh.], *Angas.*	L. dissimilis, *Desh.*
Spisula Adelaidæ, *Angas.*	Mactra ovalina, *Lk.*
Amphidesma glabrella, *Lamarck.*	Not recognised.
Mesodesma obtusa, *Crosse* and *Fischer.*	M. præcisa, *Desh.*
Donax deltoides, *Lamarck.*	D. epidermia, *Lk.*
Soletellina epidermia, *Reeve.* / Soletellina nymphalis, *Reeve.*	S. biradiata, *Wood.*
Psammotea candida, *Lamarck.*	Locality erroneous.
Venerupis distans, *Lamarck.*	V. exotica, *Lk.*
Chione alta [Sow.], *Angas.*	C. tiara, *Dillwyn.*
Chione australis [Sow.], *Angas.*	C. gallinula, *Lamk.*
Chione conularis, *Lamarck.* / Chione Peroni, [Lamarck], *Angas.*	C. aphrodina, *Lk.*
Circe rivularis [Menke], *Angas.*	C. corrugata, *Chemnitz*, var. crocea, *Gray.*
Marcia faba [Reeve], *Angas.*	Chione lævigata, *Sow.*
Callista Victoriæ, *T. Woods* and *Angas.*	Cytherea rutila, *Sow.*
Chama fragum [Reeve], *Angas.*	C. spinosa, *Broderip.*
Thecalia macrotheca, *Adams* and *Angas.*	Mytilicardia concamerata, *Chem.*
Lucina Cumingi, *Adams* and *Angas.*	L. quadrisulcata, *D'Orb.*
Loripes ovum [Reeve], *Angas.*	Cryptodon globosum, *Forsk.*
Crassatella sulcata, *Lamarck.*	Not known here.
Isocardia semisulcata, *Lamk.*	Not known.
Cypricardia rostrata, *Lamk.*	Locality erroneous.
Lasæa australis [Sow.], *Angas.*	Lasæa rubra, *Montagu.*
Mysella anomala, *Angas*, 1878 (non '77)	Kellia solida, *Angas.*
Perna flavida [Dunker sp.], *Angas.*	Modiola semivestita, *Dunker.*
Lanistina nana, *Dunker.* / Crenella Adolphi, *Dunker.*	Modiolaria Cumingiana, *Rv.*
Malleus regulus [Forsk.], *Angas.*	M. vulsellatus, *Lamk.*
Pinna Zeylanica, *Angas* (non Gray).	P. inermis, *Tate.*
Vulsella limæformis, *Reeve.* / Vulsella rudis, *Reeve.*	V. ovata, *Lamarck.*
Perna nucleus, *Lamarck.*	Not known.
Avicula scalpta, A. pulchella, A. rutila, and A. punctulata [all of Reeve], *Angas.*	A. Georgiana, *Quoy* and *Gaimard.*
Arca avellana, *Lamarck.*	Not recognised.

Pectunculus laticostatus, *Angas* (non Quoy and Gaimard).	P. flabellatus, *T. Woods.*
Limopsis Macgillivrayi [A. Adams], *Angas.*	L. Belcheri, *Ads.* and *Rv.*
Pecten australis [Sow.], *Angas.*	P. asperrimus, *Lamarck.*
Pecten laticostatus, *Angas* (non Gray).	P. fumatus, var. albus, *Tate.*
Lima squamosa, *Angas* (non Lamk.).	L. multicostata, *Sow.*
Ostrea cucullata [Born], *Angas.*	Not living here.
Ostrea edulis [Linn ?], *Angas.*	O. Angasi, *Sow.*

A large majority of the molluscan inhabitants of our ocean waters are common to the province which embraces the coast-line of extratropical Australia; of the Lamellibranchiata, 130 species belong to it, of which 32 are unknown at present beyond the limits of this colony; 26 species are migrants from the Indo-Pacific Province which extends to North Australia, and reaches on the west coast to Shark Bay and on the east to Port Curtis or Wide Bay; two, if not three, are cosmopolitan.

Of the species of Palliobranchs, four are essentially Australian, whilst the fifth is common to South Australia and Chili.

The greatest community of species of bivalves is with Tasmania, 75 actually known; with New South Wales, 63; with south-western Australia, 31; with Victoria, 29; and with New Zealand, 15.

The following exotic species appear sporadically, as it were, in South Australia:—*Gastrochæna lamellosa*, *Tellina capsoides*, *Venerupis exotica*, *Donax cardioides*, *Lucina fabula*, *Carditella infans*, and *Barbatia lima.*

CLASS LAMELLIBRANCHIATA.

Family Teredinidæ.

1. Teredo sp.

Burrowing in submerged timber, Holdfast Bay and Port Adelaide.

Tube thin, slender, septated internally; valves like *T. norvegica.* Siphonal pallets unknown, therefore the exact systematic position indeterminable. Possibly it may be *Xylotrya antarctica*, Hutton, inhabiting New Zealand and Queensland.

Family Pholadidæ.

2. Barnea similis, Gray, in Dieffenbach's N. Zealand, vol. 2, p. 254; also Reeve's Mon. Pholas, f. 10.

Burrowing in clay at low-tide mark, Port Lincoln, St. Vincent Gulf, and South-East coast; also in Tasmania, New South Wales, and New Zealand.

A white delicate shell, acuminate anteriorly.

3. Barnea australasiæ, Sowerby, in Thesaurus Conchyliorum, t. 107, f. 73.

Burrowing in soft rock just below low-tide mark, from the Head of the Great Australian Bight to Gulfs Spencer and St. Vincent; also in Tasmania.

Similar to the last, but rounded anteriorly.

4. Jouannetia Cumingi, Sowerby.

MacDonnell Bay *(W. Tomsett!);* also New South Wales *(J. Brazier)* and Port Darwin *(W. T. Bednall!)*

Anteriorly globose and covered by a callous plate, acuminate posteriorly.

Family Gastrochænidæ.

5. Aspergillum (Humphreyia) Strangei, A. Adams, in Proceedings Zoological Society, 1852, p. 91, t. 15, f. 15; Reeve, Mon., t. 2, f. 4.

Holdfast Bay *(W. T. Bednall!);* also Tasmania and New South Wales.

Tube stout, squarely rounded, and obtusely keeled at the angles. Length, about two and a-half inches.

6. Aspergillum (Humphreyia) multangulare, Tate, *anteà*, p. 64, t. 4, f. 4.

Holdfast and Aldinga Bays in Gulf St. Vincent, and Wallaroo Bay in Gulf Spencer.

Tube slender, polygonally rounded, angles not keeled. Total length, about one inch.

7. Gastrochæna lamellosa, Deshayes, in Proc. Zool. Soc., 1854, p. 328; Smith, in Zoology of the Challenger, pt. 35, t. 8, f. 2, p. 28, 1885.

Burrowing in sponge, Backstairs Passage, in 32 fathoms; also Philippine Islands, Cape York (Challenger Exp.), and Port Darwin (*Bednall!*)

Dorsal margin sloping, widening posteriorly; surface of valves raised into close-set lamellæ. Length, about one and a-quarter inches.

8. Gastrochæna Tasmanica, Tenison Woods, in Proc. Roy. Soc. Tasmania for 1876, p. 159. Pl. v., figs. 10*a*—10*b*.

Burrowing in limestone, forming the bed of Port Adelaide Creek; in the test of Chamæ and encrusted growth on Pinnæ, Holdfast and Aldinga Bays; also Tasmania!

Dorsal margin nearly straight, ventral gape occupying whole length of margin; surface concentrically striated. Length, under half-inch.

Family Solenidæ.

9. Solen vaginoides, Lamarck, in Animaux sans Vertebres, vol. v., p. 451, 1818.

Port Adelaide Creek; Nepean and Hog Bays, Kangaroo Island. The type specimens from Tasmania.

Shell nearly straight, about four times as long as wide, mottled with purple and flesh colour. Length, three and a-half inches.

Family Saxicavidæ.

10. Saxicava arctica, Linnæus.

In the crevices of rocks; immersed in the bases of large Ascidians, upon oysters, &c., throughout South Australia.

This polymorphic species is world-wide in its distribution. Lamarck named specimens obtained at Kangaroo Island *S. australis;* and large individuals attaining to two and a-half inches long from our waters had been provisionally named *S. Angasi* by A. Adams. It is a member of the Eocene fauna of South Australia and of the New Zealand Pliocene.

Family Corbulidæ.

11. Corbula scaphoides, Hinds; Reeve, Mon., t. 3, f. 47.

Cast up at Fowler's Bay; Wallaroo Bay; Hog Bay, Kangaroo Island; and at several localities in St. Vincent Gulf. Dredged in life from eight to 22 fathoms in Encounter Bay (*Pulleine!*); also New South Wales, North Australia, and the East Indies.

Distinguished by being nearly equivalve, by its small umbones and radial sculpture; length five-eighths of an inch. Angas has catalogued it in Proc. Zool. Soc., p. 869, 1878, as *C. nasuta.*

12. Corbula tunicata, Hinds; Reeve, Mon., t. i., f. 5.

Dredged in life from 22 fathoms, Encounter Bay (*Pulleine!*); Aldinga Bay; also New South Wales to North Australia and the Philippines.

Very inequivalve; the larger valve with tumid umbones; surface with thick concentric ribs; length, five-eighths of an inch.

Family Anatinidæ.

13. Anatina Angasi, Crosse and Fischer (*Periploma*), in Jour. de Conch., 1864, p. 349; 1865, p. 427, t. 11, f. 1.

Hardwicke Bay, Spencer Gulf (*Angas*); Coffin Bay (*S. Aust. Mus.!*); Port Lincoln and Port Adelaide Creek (*R. T.*). Also Tasmania and New Zealand.

Distinguished by the inequality of its valves; attaining to a length of three inches by a breadth of one and three-quarters.

14. Anatina creccina, Reeve, Mon., t. 2, f. 12.

Hardwicke Bay (*Angas*), Wallaroo (*Gosse!*), in Spencer

Gulf; Coffin Bay (*S. Aust. Mus.!*); and off the mouth of the Patawalonga, Holdfast Bay (*Bednall!*). Common at Corio Bay, Port Phillip, thence extending to Queensland.

An oblong inequilateral shell, widely gaping and curved upwards posteriorly; length, two and a half inches.

15. Anatina gracilis, Reeve, Mon., t. 2, f. 9.

Port Adelaide Creek, Holdfast Bay, and Wallaroo. Also Moreton Bay, Queensland.

A narrow oblong shell, almost equilateral, one and three-quarter inches long.

16. Myodora brevis, Sowerby; Reeve, Mon., t. 1, f. 7.

Denial Bay, Great Australian Bight. Also Tasmania to Queensland and New Zealand.

Right valve with small much incurved beak, triangular, ornamented with flexuous ribs.

17. Myodora ovata, Reeve, Mon., t. 1, f. 4.

Port Adelaide Creek(!); Encounter Bay (*R. H. Pulleine!*). Also Tasmania and New South Wales; doubtfully Philippine Islands (*Reeve*).

Right valve ovate, somewhat triangular, with about 20 thick concentric ribs.

18. Myodora angustata, Angas (*Alicia*), in Proc. Zool. Soc., 1867, t. 44, f. 1, p. 908.

Dead shells dredged in 22 fathoms, Encounter Bay (*R. H. Pulleine!*). Also in New South Wales.

A narrowly oblong shell with the aspect of a *Thracia*, upon which Angas founded the genus of *Alicia*, but which E. A. Smith, in Voy. of Challenger, removed to *Myodora*; length, half an inch.

Family Mactridæ.

19. Mactra rufescens, Lamarck, An. s. Vert., v., p. 476.

Great Australian Bight; Encounter Bay and southward. Extends from Shark Bay (*Lamarck*) to Tasmania.

Broadly triangular, solid, pale-brown, somewhat pointed at the extremities, towards which the surface is flexuously wrinkled; length, two inches.

20. Mactra pura, Deshayes, in Proc. Zool. Soc., 1853, p. 15.

St. Vincent and Spencer Gulfs; Fowler Bay, Head of the Great Bight, and Eucla. Also King George Sound and Tasmania.

Solid, ivory-white beneath a light-brown silky epidermis; larger, more solid, and less equilateral than the last; length, one and three-quarter inches.

21. Mactra polita, Chemnitz ; *M. australis*, Lamarck, An. s. Vert., v., p. 475.

Common in sand at low water. St. Vincent and Spencer Gulfs ; Fowler Bay and Head of Great Australian Bight. Also King George Sound (Lamarck's type).

Triangularly ovate, rounded anteriorly ; banded with light-grey and violet beneath a pale-brown epidermis ; length, one and a half inches.

22. Mactra jacksoniensis, E. A. Smith, Voy. Challenger, t. 5, fig. 9, p. 62, 1885.

Hog Bay, Kangaroo Island ; Streaky Bay, Great Australian Bight. Also Port Jackson !

Triangularly elongate, equilateral, shining usually white rayed with brown ; five-eighths of an inch long.

23. Mactra amygdala, Crosse & Fischer, in Journ. de Conch., 1865, p. 426, t. 11, f. 3.

Head of Spencer Gulf (*Angas*).

An oval white species, truncated posteriorly, about half an inch long.

24. Mactra (Hemimactra) versicolor, Tate, *anteà*, p. 64, t. 4, figs. 12*a*—12*b*.

Lake MacDonnell towards the Great Australian Bight.

Triangularly ovate, obliquely truncated behind, shining, white, yellow, brown, purplish or bluish-white, concentrically lirate ; length, half an inch.

25. Mactra (Hemimactra) ovalina, Lamarck in An. s. Vert., v., p. 477 (1818). *Spisula Adelaidæ*, Angas in Proc. Zool. Soc., 1865.

Holdfast, Aldinga, and Encounter Bays ; Port Adelaide Creek (type of *S. Adelaidæ*). Also Victoria and New South Wales.

Ovate, white, rufous tinted about the umbos, posterior slope slightly keeled, rather gaping posteriorly ; about one inch long by three-eighths high.

26. Mactra (Mulinia) pinguis, Crosse & Fischer, Journ. de Conch., 1865, t. 11, f. 2, p. 427.

Port Lincoln (*Angas*).

Oval trigonal, much inflated and thick, fulvous, colour darker towards the extremities ; length about one inch.

27. Lutraria rhynchæna, Reeve, Mon., t. 4, f. 16.

Dredged on oyster banks off Port Lincoln (*Angas*).

Obliquely arched, with the anterior side beaked.

28. Lutraria dissimilis, Deshayes, in Proc. Zool. Soc., 1854, p. 72.

Surveyor's Point, Port Adelaide Creek, and Aldinga Bay, in St. Vincent Gulf; Port Lincoln, Fowler's Bay; also Tasmania and New South Wales.

A large thick species attaining to three and four inches long; ventral and dorsal margins nearly parallel, covered with a dirty brown epidermis.

Family Scrobiculariidæ.

29. Semele Ada, Adams and Angas, in Proc. Zool. Soc., 1863, p. 426. Plate v., fig. 8.

Port Adelaide Creek (*Angas*), Holdfast Bay, Wallaroo Bay, and Fowler Bay.

Transversely-ovate, thin, white, compressed, concentrically rugose-plicate, excavated in front of the acute umbos; front side rounded, posterior side shorter, obtuse-angled; under half an inch long.

30. Semele exigua, H. Adams, in Proc. Zool. Soc., 1861, p. 385. Plate v., fig. 5.

Holdfast Bay, Stansbury, and Streaky Bay. In sand near low tide mark, Spencer Gulf (*Angas*).

The type specimens are reported from Tasmania, but according to Tenison Woods the species is not known there.

A white oblong shell, finely concentrically striated, posterior side subangulated with a strong fold continued to the ventral margin; length, about five-eighths of an inch.

Family Paphidæ.

31. Mesodesma præcisa, Deshayes, in P. Z. S., 1854; id. Reeve, Mon., t. 4, f. 31. *M. obtusa*, Crosse and Fisher, Journ. de Conch., 1865, t. 11, f. 4, p. 428.

In sand at low water, Holdfast Bay, and west shore of St. Vincent Gulf, Port Lincoln! (type locality of *M. obtusa*); Streaky and other bays in the Great Australian Bight; Spencer Gulf.

This species was founded on Tasmanian specimens; it also inhabits King George's Sound!

Ovate, waxy-white, roundly truncate behind; about one inch long.

32. Mesodesma elongata, Deshayes, P. Z. S., 1854; id. Reeve, Mon., t. 1, f. 25.

On all sandy beaches, and occurs all round Australia.

Triangularly elongated, posterior side short and truncated, light-horn coloured; under one inch long.

33. Anapa cuneata, Lamarck (*Crassatella*), An. s. Vert., v., p. 483. *Mesodesma cuneata*, Reeve, Mon., t. 2, f. 9.

Towards high-tide mark. Port Adelaide Creek and west shore of St. Vincent Gulf; Port Lincoln; Denial and Laura Bays; Kangaroo Island (Lamarck's types).

A thick triangular shell, produced posteriorly, whitish, concentrically striated; length, about one inch.

34. Anapa triquetra, Hanley, Proc. Zool. Soc., 1843, p. 101; Reeve, Mon. of Mesodesma, t. 4, f. 28. *Anapa Smithii*, Gray; *Anapa Tasmanica*, Tenison-Woods.

Between tide marks, Port Adelaide Creek. Head of Spencer Gulf (*Angas*).

The type shell is from Tasmania.

Similar to the last, more tumid, less inequilateral, and somewhat truncated posteriorly.

Family Tellinidæ.

35. Donax epidermia, Lamarck, An. s. V., v., p. 548. *D. deltoides*, Lamarck, op. cit., p. 547.

Very abundant on the sandy shores extending southward from Encounter Bay. The Lamarckian types were collected by Peron at Kangaroo Island.

This species ranges from King George Sound to Queensland, though not recorded for Tasmania.

Cuneate, smooth except on the posterior area, which is radially striated; colour greenish, yellow, purplish; inner margin of valves smooth; length, about two inches by one and a quarter.

36. Donax cardioides, Lamarck, An. s. V., v., p. 550; id. Quoy and Gaimard, Voy. Astrolabe, t. 81, f. 17-19, vol. 3, p. 495.

Dead shells dredged in 22 fathoms, Encounter Bay (*R. H. Pulleine!*); cast up southern Yorke Peninsula (*J. G. McDougall!*). St. Peter and St. Francis Isles (Lamarck's types). Also New Guinea, Tahiti, and New Ireland (*Quoy and Gaimard*). Aru Islands (coll., *W. T. Bednall!*).

Trigonal, medially inflated, radiately ridged, umbos prominent, spotted with reddish-brown; inner margin of valves denticulated; length, about three-quarters of an inch.

37. Donax sordida, Reeve, Mon., t. 4, f. 32.

Port Lincoln (*Angas*).

At low tide on the sandy beach at the Head of the Great Australian Bight; cast up, Hog Bay, Kangaroo Island. Locality of type unknown.

Cuneiform, flattened, umbos small, posterior side very short,

radiately striated; colour white, greenish, orange, purplish; inner margin of valves denticulated. Length, three quarters of an inch.

38. Psammobia zonalis, Lamarck (*Psammotea*), An. s. Vert. v., p. 517.

Hog Bay, Kangaroo Island (*R. T.*), Encounter and Guichen Bays (*R. H. Pulleine!*). Also Tasmania, N. S. Wales, Queensland, Philippine Islands, &c.

Ovately transverse, truncated posteriorly, compressed, concentrically finely striated, pale brown with white rays. Length, about one and a half inches.

39. Psammobia Brazieri, Tate, *anteà*, p. 65., t. v., f. 1.

Aldinga and Holdfast Bays.

40. Sanguinolaria vitrea, Deshayes in P. Z. S., 1854, p. 326; id. Reeve, Mon., t. 1, f. 1.

Port Lincoln and Spencer Gulf (*Angas*); Surveyor's Point and Holdfast Bay. Also Tasmania.

Shell thin, white, transparent, narrow-oblong; dorsal and ventral margins nearly parallel, marrower than young of *Soletellina biradiata*. Length, three quarters to one inch.

41. Soletellina biradiata, Wood (*Solen.*), in Gen. Conch., t. 33, f. 1; Reeve, Mon., t. 2, f. 7; *S. epidermia*, Reeve, Mon., t. 1, f. 3, and *S. nymphalis*, Reeve, Mon., t. 1, f. 2,

In sand below low tide mark, common in St. Vincent and Spencer Gulfs, Fowler's Bay, and Port Adelaide (types of *S. epidermia* and *S. biradiata*, Reeve). The species ranges from King George Sound to New South Wales.

S. epidermia and *S. nymphalis*, Reeve, are mere colour varieties of *S. biradiata*.

Shell roundly oblong, colour white, yellow to purple, with two white rays from the umbo to the post-ventral margin, which is rapidly ascending. Length, two and a quarter inches.

42. Soletellina donacioides, Reeve, Mon., t. 3, f. 11, 1857.

Port Adelaide Creek (type in Cuming Coll.); St. Vincent Gulf (*W. T. Bednall!*).

Transversely-oblong, livid purple, with two faint posterior rays; posterior side more oblique than in the last species. Length, two and a quarter inches.

Perhaps conspecific with *Psammobia florida*, Gould, which name has priority, in which case the species inhabits also New South Wales.

43. Tellina albinella, Lamarck, An. s. Vert., v., p. 524 (1818), id. Römer, Mon. Tellin, t. 27, f. 1—4 (1872).

Abundant on the sandy beach about the mouth of the River Murray; occasionally in Holdfast and Aldinga Bays; St. Peter and St. Francis Isles (Lamarckian types); Fowler's Bay. Extends to Tasmania and New South Wales.

About two inches long, oval, compressed, subangulated posteriorly; pink or orange, rarely white.

44. Tellina deltoidalis, Lamarck, op. cit., p. 532 (*exclus. var. b.*). *T. lactæa*, Quoy and Gaimard, Voy. Astrolabe, t. 81, f. 14—16.

Between tide marks in the estuary of the Port Adelaide Creek, the Patawalonga and Onkaparinga, St. Vincent's Gulf; Encounter Bay; also St. Francis Isles (Lamarckian types). It occurs in Victoria, Tasmania, and New South Wales; New Zealand, New Caledonia, Acapulco.

Shell roundly triangular, compressed, subrostrated, white. Length, about one inch.

45. Tellina capsoides, Lamarck, An. s. V., v., p. 531; id. Römer, Mon. Tell., t. 14, f. 1—3.

St. Peter and St. Francis Isles; also at the Philippines (*Peron, Lamarck*).

Broadly trigonal, subequilateral, concentrically and radiately striated; anterior side bisulcated; white. Length, one and three-quarter inches (*Lamarck*).

46. Tellina tenuilirata, Sowerby, in Reeve, Mon., t. 39, f. 219.

Hog Bay, Kangaroo Island; Streaky Bay; Port Adelaide Creek; also New South Wales, N. Australia, and Fiji.

Oblong, posterior side very short, cuneiform; post-ventral margin rapidly ascending; concentrically finely ridged. Length, three-eighths of an inch.

47. Tellina subdiluta, Tate, *anteà*, p. 65, t. 4, f. 9.

Encounter Bay, in 22 fathoms.

Ovately oblong, rounded on the very short posterior side, attenuated anteriorly; finely concentrically ridged. Length, three-eighths of an inch.

48. Tellina ensiformis, Sowerby, in Reeve, Mon., t. 49, f. 289 (1868).

Aldinga Bay; Australia (*Sowerby*).

Left valve, broadly triangular-ovate subequilateral, much curved longitudinally, attenuated and subrostrated behind; transparent, white; length one inch, width a little more than half-inch.

49. Tellina Aldingensis, Tate, *anteà*, p. 66, t. 5, f. 2.

Aldinga Bay.

50. Tellina decussata, Lamarck, An. s. Vert., v., p. 532; Römer, Mon. Tellina, t. 23, f. 1—3, 1873.

Occurs on the whole length of our coast. but is not a common shell. It ranges from King George Sound (*Lamarck*) to New South Wales.

Orbicular with decussate ornament, about two inches diameter.

51. Macoma Mariæ, T. Woods, in Proc. Roy. Soc. Tasmania for 1875, p. 162, as a Tellina; *Macoma rudis*, Bertin, Archives Mus. Hist. Nat., 1878, t. 9, f. 2, p. 335.

St Vincent Gulf, Fowler's Bay, Streaky Bay, Encounter Bay, Lacapede Bay; only at the last locality is it at all common.

Bertin's type is from Port Philip. I have collected the species at Corio Bay. Tasmanian examples of *M. Mariæ* perfectly agree with description and figures of *M. rudis*. Tenison Woods implies in his description of the species a reference to the genus Macoma, and the diagnosis is amply sufficient for identification.

Transversely elliptical, white, gaping, and roundly truncated posteriorly; length up to one and a quarter inches.

52. Metis umbonella, Lamarck (*Tellina*); An. s. Vert., v., p. 532; id. Hanley Mon. Tellina, t. 56, f. 13; Reeve, Mon., t. 38, f. 214.

Port Lincoln (Cuming coll.); King Island (Lamarck).

The Australian localities have been usually considered to be erroneous. The species is not known here, and Tenison Woods does not mention it in his census of Tasmanian Marine Shells. Bertin says, however, it inhabits New Holland, and is represented in the Paris Museum by an original specimen from King Island (type of Lamarck). So far as known, it would appear to be peculiar to Southern Australia.

Family Petricolidæ.

53. Naranio divaricata, Chemnitz, sp. *Petricola lucinalis*, Lamarck, loc. cit., p. 504.

Holdfast and Aldinga Bays, Port Lincoln. Also at King George Sound (*Lamarck*), Port Darwin!, and Indian Ocean.

Thin, ventricose, divaricately sculptured.

54. Venerupis exotica, Lamarck, An. s. Vert., v., p. 507; Reeve, Mon., t. 2, f. 11; *V. distans*, Lamarck, op. cit., p. 507.

Streaky Bay (R. T.); Corney Point, Yorke Peninsula (*McDougal!*); St. Francis Isles (*Lamarck*).

V. distans was described from specimens collected by Peron at St. Peter and St. Francis Isles; the species has not been recognised, but from the diagnosis it should be absorbed in

V. exotica. The locality of the type of *V. exotica* is unknown, but the species occurs in North Australia.

Ovate rhomboidal, post-dorsal and ventral margins nearly parallel, radially costated, transverse lamellæ few and distant, white or yellowish, painted with red angular lines posteriorly.

55. Venerupis carditoides, Lamarck, loc. cit., p. 508; Reeve, Mon., t. 1, f. 5.

Hog Bay, Aldinga Bay, Port Adelaide Creek, Encounter Bay. Also West Australia and Tasmania, New Holland (*Lamarck*).

Very closely allied to the last, the dorsal margins more sloping, concentric lamellæ more numerous.

56. Venerupis crenata, Lamarck, loc. cit., p. 508; Reeve, Mon., t. 1, f. 3.

At the roots of mangrove trees, Port Adelaide Creek (*Angas*); Noarlunga, Encounter and Guichen Bays. Also Tasmania and New South Wales, New Holland (*Lamarck*).

This, the largest of our species, is oblong, rather inflated, concentrically exfoliated and irregularly frilled, decussated by radial costæ.

57. Venerupis crebrelamellata, Tate, *anteà*, p. 66, t. 4, figs. 14*a*—14*b*.

Burrowing in stiff clay at the mouth of the Patawalonga, Holdfast Bay.

Narrow oblong, attenuated in front, densely concentrically exfoliated frilled; nearly one inch long.

58. Venerupis mitis, Deshayes, P. Z. S., 1853; Reeve's Mon., t. 4, f. 24.

Port Elliot. Also New South Wales.

Oblong, rectangular, concentrically ridged and striated, densely radially costated; attaining to three-fourths of an inch.

59. Venerupis Cumingi, Deshayes, P. Z. S., 1853, t. 18, f. 3; Reeve's Mon., t. 3, f. 18.

In the crevices of rocks and hollow stones, Rapid Bay and Encounter Bay! (*Angas*). Type without locality.

Shell ovate; left valve included in the right; concentrically exfoliated, frilled.

60. Venerupis obesa, Deshayes, P. Z. S., 1853, p. 5; Reeve's Mon., t. 3, f. 13.

Encounter Bay (*Angas*); also Victoria (type) and Tasmania.

Family Veneridæ.

61. Tapes fabagella, Deshayes, P. Z. S., 1853, p. 10; Reeve's Mon., f. 66; *Venerupis reticulata*, Tenison Woods

P. R. S. Tasm. for 1875, p. 159; *Tapes Victoriæ*, T. Woods, P. R. S., Vict., xiv., p. 60, 1878.

In crevices of the limestone floor of Port Adelaide Creek, Aldinga and Holdfast Bays; Encounter Bay; also Tasmania! Victoria! and New South Wales; erroneously credited to New Zealand.

Decussately striated, painted with angular rufous lines on the posterior slope. Length, three-fourths of an inch.

62. Tapes galactites, Lamarck, An. s. Vert., v., p. 599; Reeve's Mon., f. 65.

Southern coast from Eucla to Guichen Bay, and throughout St. Vincent and Spencer Gulfs; also King George Sound (type) and New South Wales.

White, with radial striations. Length, one and a-half inches.

Genus Chione.

(a) *With membranous lamellæ.*

63. Chione lamellata, Lamarck (*Venus*), An. s. Vert., v., p. 592; Reeve's Mon. (*Venus*), f. 78.

Hardwick Bay; Port Lincoln; Coffin's Bay, Encounter Bay, and South-East coast; also Victoria, Tasmania (type), and New South Wales.

Ovately-oblong, with about twelve concentric flesh-coloured elevated undulose frills, which are striated on the ventral face. Length, two and a-quarter inches; frills, about ten at that size.

64. Chione tiara, Dillwyn (*Venus*); Reeve, Mon., t. 67, f. 3.

Port Lincoln (*Angas, Bednall!*); Kangaroo Island (*R.T.*); Semaphore (*Forwood!*); St. Vincent Gulf (*S. Aust. Mus.!*); also West Australia, Queensland, and Indian Ocean.

Cordately ovate; lamellæ thick, broad, and few.

I have united the species *C. alta*, Sowerby, and *C. tiara*, which Angas has quoted separately for South Australia.

65. Chione roborata, Hanley, P. Z. S., 1844, p. 161.

Hog Bay, Kangaroo Island; and Aldinga Bay, St. Vincent Gulf.

Cordately ovate, with numerous, smooth, concentric, thick ridges curved inwards; white, or with pale-pink rays; about one inch long.

(b) *Lamellose, radiately striated; margin of valves crenulated.*

66. Chione gallinula, Lamarck (*Venus*), An. s. Vert., v., p. 591; *V. lagopus*, Lamarck; *V. Humphreyi*, Donovan; *V. australis*, Sow.; *V. costulata*, Gray.

Port Lincoln, Kangaroo Island, Aldinga Bay, Edithburgh, Encounter Bay, South-East coast. Ranges from south-west Australia to New South Wales.

Cordately elliptical, closely covered with thin, erect, short lamellæ, elegantly ornamented with brown angular lines on a whitish ground; length, one and a quarter inches.

The type of *V. gallinula* is from King Island, in Bass Straits, whilst those of *V. lagopus* and *V. australis* are from King George Sound. Deshayes and other authors keep distinct *C. gallinula* and *C. australis*, and both appear in the lists for New South Wales (*Angas*), Tasmania (*T. Woods*), and West Australia; whilst Angas records *V. australis* only for South Australia. The few specimens of *C. gallinula* from the type locality which I have studied are certainly a little higher proportionately than our so-called *C. australis*, but I cannot find any other differential characters. Young shells present much individual variation in respect to outline, strength of the lamellæ, and radial striation, and are inseparable from *C. striatissima*, Sow.

(c) *Concentrically thinly ridged or striated; margin of valves plain.*

67. Chione strigosa, Lamarck (*Venus*), An. s. Vert., v., p. 605.

Sandy shores at low tide. Great Australian Bight; Port Lincoln; St. Vincent Gulf. Also King George Sound (type) and Victoria.

Ovately oblong, with wavy ridges coarsely crenulated; more elongated, less oblique, and flatter than its allies; length, one and a half inches.

68. Chione aphrodina, Lamarck (*Venus*), An. s. Vert., v., p. 605. *V. conularis* and *V. Peroni*, Lamarck.

Sandy shores at low tide; Great Australian Bight (St. Francis Isles for type of *V. conularis*); Kangaroo Island (for type of *V. aphrodina*); St. Vincent Gulf; also King George Sound (for type of *V. Peroni*) and Tasmania. (Maria Island, *Lamarck*).

More inflated, and rounder than its allies; transverse ridges plain, broadish, and flat.

69. Chione scalarina, Lamarck (*Venus*), An. s. Vert., v., p. 599; *V. aphrodinoides*, Lamarck; *V. nitida*, Quoy and Gaimard, t. 84, f. 13, 14, vol. 3, p. 529 (1835).

Sandy shores at extreme low-water mark. Very abundant in Holdfast Bay—used for food and bait for fishing. It ranges from Swan River (*Angas*) and King George Sound! to Tasmania.

Somewhat cordate, oblique; transverse ridges acute, slightly elevated, numerous; white, spotted with brown, violet posteriorly.

(d) *Valves smooth.*

70. Chione lævigata, Sowerby *(Venus)*, Thesaurus Conch., t. 159, f. 156—8; *Marcia faba* [Reeve], Angas.

Estuary of the Port Adelaide Creek, of the River Onkaparinga, and of the River Glenelg; Surveyor's Point, St. Vincent Gulf; and the Great Australian Bight. Also Victoria, Tasmania, and New South Wales.

The specimens from the estuary of the Onkaparinga which Angas has identified with *C. faba*, Reeve, are not separable from *C. lævigata* of more southern localities.

Rather inflated, ovate, acuminate posteriorly; colour brown or fawn, often with lighter-coloured rays from the umbones; length, one and three-quarter inches.

71. Chione undulosa, Lamarck (*Venus*), An. s. Vert., v., p. 606; *V. variabilis*, Sowerby.

Port Lincoln; Holdfast Bay; Guichen and Robe Bays. Also Shark Bay and King George Sound (type), New South Wales, and North Australia.

Triangularly ovate, white, rayed with angular, undulating, reddish-brown lines or blotches; length, one inch.

72. Circe corrugata, Chemnitz. Var. C. crocea, Gray; *Cytherea rivularis*, Menke, Moll. Nov. Holl., p. 42.

Port Lincoln; Kangaroo Island; Noarlunga; Port Adelaide Creek. Also West and North Australia, Queensland, and the Indian Ocean.

Depressed, lenticular, with flattened contiguous umbos, surface concentrically corrugated; two inches in the larger diameter.

73. Dosinia grata, Deshayes, Brit. Mus. Cat., p. 10; *D. Diana*, Adams and Angas, Proc. Zool. Soc., 1863, p. 424. Pl. v., fig. 15.

Hardwicke Bay, Spencer Gulf (*Angas*); Hog Bay, Kangaroo Island; Encounter Bay; South-East coast (*Bednall!*). Also Tasmania! (type).

Orbicular, white, gibbous, very smooth in the umbonal region; concentric liræ depressed, crowded, microscopically very closely radiately striated; length, one and three-quarter inches.

D. Diana was founded on South Australian specimens which I fail to separate from Tasmanian examples of *D. grata*.

74. Dosinia crocea, Deshayes, Brit. Mus. Cat., Conchifera, p. 10.

Port Adelaide Creek; Aldinga Bay and Surveyor's Point, in St. Vincent Gulf; Port Lincoln; South-East (*Bednall!*); Flinders Island (*Deshayes*).

Orbicular, depressed, with close, regular, erect, thin, concentric lamellæ; white, sometimes rufous spotted; lunule rufous red; length, one and a half inches.

75. Meroe Aliciæ, Adams and Angas (*Sunetta*), Proc. Zool. Soc., 1863, t. 37, f. 18.

Cape Spencer, Southern Yorke Peninsula (*J. G. McDougall!*); Encounter to Guichen and Robe Bays; also Victoria (*Bednall!*).

Ovate cordate, smooth; white, yellowish, or red; sometimes blotched with purplish-red; margin of valves finely crenulated. Length, one inch.

76. Cytherea Diemensis, Hanley, Proc. Zool. Soc., 1844, p. 110; *C. multistriata*, Römer's Mon., Reeve's Mon.

Dredged in life from ten fathoms off Holdfast Bay (*S. Aust. Mus.!*); also Tasmania (type).

Oblong-ovate, fulvous, rayed with ashy purple. Length, one and a-half inches.

77. Cytherea rutila, Sowerby, Thes. Conch., t. 163, f. 205; *Mercenaria paucilamellata*, Dunker; *Callista Victoriæ*, Tenison Woods, P. R. S. Tasm. for 1875, p. 159.

Sandy exposed coasts, south from Encounter Bay; also Victoria, Tasmania, and New South Wales.

Very solid, more trigonal than the last, usually with a few thick small lamellæ anteriorly; chesnut, coloured with broad rays of lighter tint. Length, two inches.

Family Cycladidæ.

78. Sphærium Macgillivrayi, E. A. Smith, Proc. Lin. Soc., xvi., t. 7, f. 34, p. 305, 1882.

Tatiara Creek, Bordertown (*Tomsett!*); also Penrith, N. S. Wales (type).

79. Pisidium Etheridgei, E. A. Smith, loc. cit., t. 7, f. 35, p. 306.

Valley Lake, Mount Gambier; also Yan-Yean Reservoir, Victoria (type).

80. Corbicula Angasi, Prime, Journ. de Conch., xii., p. 151, t. 7, f. 6, 1864; *C. rivina*, Clessin.

River Murray (type) and Lake Alexandrina, and in most of the perennial streams within the drainage area of the Lower

Murray. Rivers Onkaparinga, Torrens, and Para. Also Muddy Creek, Hamilton, Victoria (*R.T.*).

81. Corbicula Deshayesi, E. A. Smith, Proc. Lin. Soc., xvi., t. 7, f. 28-29, p. 303.

Dead shells only on the north-east shore of Lake Alexandrina. Types from Victoria R. and Port Essington, North Australia.

82. Corbicula desolata, Tate, *antea*, p. 67, t. 4, f. 11.

Cooper's Creek at Innamincka (*James McLeod!*).

Family Cardiidæ.

83. Cardium pulchellum, Gray in Dieffenbach's N. Zealand, ii., p. 252 ; id. Reeve, Mon., t. 8, f. 42.

Dredged in life from 6 fms. off the Orontes bank in St. Vincent Gulf ; Kangaroo Island (*S. Aust. Mus.!*). Also Victoria, Tasmania, New South Wales, and New Zealand.

Finely radially costated, posterior slope with sharp tubercles, whitish with orange-coloured rays. Length, seven-sixteenths of an inch.

84. Cardium tenuicostatum, Lamarck, An. s. Vert., vi., p. 5 (1819); Reeve's Mon., f. 50.

From the Head of the Great Bight to Port Lincoln ; Spencer and St. Vincent Gulfs, throughout the temperate waters of Australia ; also at the Philippines ; New Holland and Timor (*Lamarck*).

Thin, ventricose, slightly oblique, rayed with numerous fine ribs, surmounted by epidermal frills ; flesh-coloured waves on a white or yellowish ground, umbones purple. Length, two inches.

85. Cardium cygnorum, Deshayes, P. Z. S., 1854, p. 331.

Same South Australian localities as the last, though much less common ; also Swan River (type) and Tasmania.

Ovate, depressed, slightly oblique ; about 40 narrow elevated radial costæ, crenulate on the sides ; white, yellow at the margins, spotted with reddish-brown. Length, one and a-half inches ; height, one and three-quarter inches.

86. Cardium foveolatum, Sowerby, Conch. Illustrations, f. 65.

Dead shells at Point Riley, Wallaroo Bay; also West Australia (type).

Similar to the last ; very solid, not oblique, narrower, and with 24 costæ.

Family Chamidæ.

87. Chama spinosa, Broderip, Trans. Zool. Soc., i., t. 38, f. 8, 9 ; *C. fragum* [Reeve], Angas.

On rocks beyond low tide, Fowler's Bay to Port Lincoln; Spencer and St. Vincent Gulfs; also New South Wales and Lord Hood's Island (type).

Concentrically frilled with rows of short irregular imbricate spines; white, tinged with red.

88. Chama cristella, Lamarck (?), An. s. Vert., vi., 96.

Same localities as the last species, to which it bears a strong resemblance; concentric lamellæ, with foliar expansions. Indian Ocean (*Lamarck*).

89. Chamostrea albida, Lamarck, An. s. Vert., vi., p. 96.

Port Lincoln; Kangaroo Island; St. Vincent Gulf; South-East coast; also Tasmania, New South Wales, and New Zealand.

Right valve very convex, keeled, *attached* by its anterior side; beaks anterior subspiral; white, smooth; left valve flat; about two inches in diameter.

Family Lucinidæ.

90. Lucina fabula, Reeve's Mon., t. 11, f. 69 (1850).

Streaky Bay; Wauraultie, Spencer Gulf; Surveyor's Point, St. Vincent Gulf; Encounter Bay. [Polynesia, *Reeve.*]

Shell flat, concentric ridges ending in slight serratures on the post-dorsal margin. Length, a little exceeding half an inch.

91. Lucina Tatei, Angas, Proc. Zool. Soc., 1878, t. 54, f. 15.

Fowler and Streaky Bays, Port Lincoln, St. Vincent Gulf, and South-East coast.

Quadrately ovate, front dorsal margin deeply excavated, concentrically and radiately ridged; length, three-eighths of an inch.

92. Lucina concentrica, Adams & Angas, Proc. Zool. Soc., 1863, t. 37, f. 19.

Streaky Bay, Port Lincoln, Wauraultee in Spencer Gulf, Edithburgh, Holdfast Bay.

Orbicular, subglobose, with thin erect distant concentric ridges, radially striated; length, nearly one inch.

93. Lucina crassilirata, Tate, *antea*, p. 67, t. 4, f. 2.

Streaky Bay.

Orbicular, subglobose, with thick concentric ridges; length, about quarter of an inch.

94. Lucina quadrisulcata, D'Orbigny, Voy. Amer. Merid. Moll., Cuba, t. 27, f. 34, 36; *L. Cumingi*, A. Adams & Angas, P. Z. S., 1863, t. 37, f. 20.

St. Vincent Gulf (type specimen, *Angas*); Middleton (*R. H. Pulleine!*); and South-East coast.

Shell orbicular, divaricately ridged.

The South Australian shell has been merged by several authors into *L. dentata*, Wood, but E. A. Smith in Moll. Challenger Exped. has very properly shown the invalidity of such association. On the authority of Mr. Cook (Ann. and Mag. Nat. Hist., 1886), *L. Cumingi* is made a synonym with *L. quadrisulcata*, and has a wide geographic range.

95. Loripes icterica, Reeve (*Lucina*), Mon., t. 10, f. 60.

Throughout South Australian waters, extending to New South Wales.

Globose, white, finely concentrically and radiately striated.

96. Cryptodon globosum, Forskal, Descript. anim. Egypt; *Lucina ovum*, Reeve, Mon., t. 5, f. 21.

Port Lincoln; Salt Creek, and Holdfast Bay in St. Vincent Gulf; Encounter Bay. Somewhat rare in a living state, but abundant in the Pleistocene beds, Port Adelaide. Also New South Wales, Queensland, Philippines, Red Sea.

Orbicular, swollen, thin, about one inch long.

Family Ungulinidæ.

97. Diplodonta globularis, Lamarck (*Lucina*), An. s. Vert., v., p. 544; *Lucina globularis*, Reeve, Mon., t. 9, f. 23.

Fowler's Bay; St. Vincent Gulf; Encounter Bay.

The Lamarckian type is from King George Sound; and the species also occurs in New Zealand, as recorded by Lamarck.

Shell globose, inflated, subequilateral; hinge line straight, rounded at both ends.

98. Diplodonta Tasmanica, Tenison-Woods, Proc. Roy. Soc., Tasm., for 1876, p. 158.

Holdfast Bay. Also Tasmania!

Shell quadrately orbicular; anterior side short, its margin rapidly descending; hinge line straight, posterior side wider and depressed; length and height, from one-third to an inch.

Family Erycinidæ.

99. Montacuta meridionalis, Tate, *anteà*, p. 68, t. 5, f. 4.

Shell sand, Aldinga Bay and Port Lincoln.

Ovately orbicular, thin, transparent, rather inflated, concentrically finely striated; length, three-eighths of an inch.

100. Kellia solida, Angas, Pro. Zool. Soc., 1877, p. 176, t. 26, f. 25; *Mysella anomala*, Angas, P. Z. S., 1878, p. 870 (*non.* Angas, 1877).

Shell sand. St. Vincent Gulf; Fowler's Bay. Also New South Wales (*Angas*).

Quadrately ovate, translucent, shining, anterior side short, posterior extremity roundly truncate; length, three-eighths of an inch. Left valve with one conical tooth in front of the cartilage pit, with a lamelliform tooth close to it; there is a rather distant lamelliform tooth on the posterior side. Right valve with a laminar tooth in front of the cartilage notch, and a similar one posteriorly, but more distant.

This species resembles externally *Mysella anomala*, with which Angas confounded South Australian specimens of *K. solida* sent to him by me for identification, under which name it appears in the above-quoted paper.

101. Kellia rotunda, Deshayes (*Erycina*), Proc. Zool. Soc., 1855, p. 181; E. A. Smith, Moll. Challenger Ex., t. 21, f. 5, p. 202.

Dredged in shallow water and cast up, Holdfast, Aldinga, and Encounter Bays. Extends to Queensland.

Shell somewhat globose, inflated, having much the form of *Diplodonta globularis*; dentition as in *K. solida*, but the cardinal tooth in the left valve is sometimes obsolete.

102. Kellia Angasiana, Tate, *anteà*, p. 68, t. 5, f. 7.

Shell sand. Holdfast Bay.

Minute, triangularly oval, sculptured with raised concentric threads.

103. Pythina Deshayesiana, Hinds.

Shell sand, Fowler Bay to Port Lincoln, Spencer and St. Vincent Gulfs; Encounter Bay and South-East coast; also Tasmania.

Roundly-oblong, divaricately ribbed, marginal ribs lamellose; umbonal area smooth.

104. Pythina Tasmanica, Tenison Woods, Proc. Roy. Soc. Tasm. for 1875, p. 162. Plate v., f. 12.

Fowler and Streaky Bays; St. Vincent Gulf; also King Island, Bass Straits (type).

Suborbicular, divaricate ribs, latticed with concentric sulcations.

105. Pythina gemmata, Tate, Trans. Roy. Soc. S. Aust., 1879, t. v., f. 8.

Shell sand, Fowler Bay; Streaky Bay.

Ovately-oblong, sculptured with divaricating granulose plicæ. Length, about one-tenth of an inch.

106. Lepton australe, Angas, Proc. Zool. Soc., 1878, t. 54, f. 14, p. 863.

Holdfast Bay and Salt Creek, St. Vincent Gulf; Streaky Bay; also in the Pleistocene shell-limestone of the Port Adelaide Creek, not uncommon.

Quadrately orbicular, flat, umbo produced, acute, a little in front of the centre; microscopically sculptured with concentric and radial striæ; attains to three-eighths of an inch long.

107. Lepton trigonale, Tate, Trans. Roy. Soc. S. Aust., 1879, t. 5, fig. 5.

Fowler and Streaky Bays, Port Lincoln, St. Vincent Gulf.

Trangularly ovate, with finely shagreen-sculpture on the sides, umbones produced, small, acute.

108. Lepton ovatum, Tate, *anteà*, p. 68, t. 5, f. 11.

In shell sand, Holdfast Bay.

Minute, ovate-oblong, umbones obtuse, oramented with distant growth lines and very minute granules.

109. Lasæa rubra, Montague.

Between tide marks in rock crevices and among mussels, &c.; throughout our coast line.

This cosmopolitan species has a host of synonyms, and the following specific names have been established on Southern examples:—*Poronia australis*, Sow., T. Woods, Angas; *Poronia purpurata*, *scalaris*, *Parreysi*, Philippi.

A minute cordately-ovate shell, varying from broadly concentrically ribbed to almost smooth; reddish to white, red stained along the hinge line.

110. Mysella donaciformis, Angas, Proc. Zool. Soc., 1878, p. 863. t. 54, f. 13.

Fowler, Streaky, and Laura Bays, Great Australian Bight; St. Vincent Gulf; also King George Sound!

A cuneiform, somewhat solid shell, about one-fourth of an inch long.

The genus Mysella (*M. anomala*, Angas, op. cit., 1877) was placed by its author in the family Tellinidæ, but the absence of a pallial sinus, the internal cartilage, and the dentition bring it in close relation to *Montacuta*.

111. Scintilla lunata, Tate, *anteà*, p. 69, t. 4, f. 8.

Creeping on rocks at extreme low tide, Edithburg, Yorke Peninsula (*McDougall*).

Ovate-lanceolate, pellucid, compressed.

Family Solemyidæ.

112. Solemya australis, Lamarck, An. s. Vert., v., p. 489.

St. Vincent Gulf; occasionally cast up in considerable numbers at Holdfast Bay; also King George Sound (type).

Cylindrical, gaping at each end, covered with a dark brown, horny epidermis extending beyond the margins.

Family Crassatellidæ.

113. Crassatella castanea, Reeve, Mon., t. 1, f. 3.

In deep water in the Port Lincoln district; Cape Jaffa, South-East coast, dead shell only (*W. T. Bednall!*). New Holland (*Reeve*).

Ovately triangular, chesnut-coloured epidermis, umbones smooth; length, attaining to four inches.

Family Astartidæ.

114. Cardita rosulenta, Tate, *anteà*, p. 69, t. 5, f. 3.

Deep water, Encounter Bay and Backstairs Passage.

Trapezoid, with 22 narrow scaly ribs, spotted with red; length, about one inch.

115. Cardita obliquissima, Tate, *anteà*, p. 70, t. 5, f. 9.

Dead shells dredged from 22 fathoms, Encounter Bay (*Pulleine!*).

Minute, very oblique, concentrically sulcated, and radially ridged on the narrow angulated posterior side.

116. Mytilicardia crassicosta, Lamarck (*Cardita*), An. s. Vert., vi., p. 24; id., Reeve, Mon., t. 2, f. 7.

Throughout South Australian waters. Also West Australia and the Philippines.

Oblong, with radiating costæ, which are raised into lamellar arched scales; colour red or pink, occasionally yellow; length, two inches.

117. Mytilicardia concamerata, Chemnitz (*Chama*); *Cardita concamerata*, Reeve, Mon., t. 9, f. 42; *Thecalia macrotheca*, A. Adams and Angas, P. Z. S., 1864, p. 39.

Under stones at low tide, Rapid Bay (*Angas*). Mr. E. A. Smith, who has compared the type of *Thecalia macrotheca* with South African specimens of this well-known species, cannot detect the slightest difference.

Ovate-oblong, radiately ribbed, a cup-shaped appendage within each valve.

118. Carditella infans, E. A. Smith, Mollusca, Challenger Exped., t. 15, f. 10, p. 218.

Rotund, solid; rose-coloured; eighteen radiating costæ separated by very narrow deep grooves, costæ with crowded transverse tubercles. The type specimens are whitish, and were obtained in 28 fathoms, south of Papua. A left valve only, dredged in 22 fathoms, Encounter Bay.

119. Carditella subtrigona, Tate, *anteà*, p. 70, t. 4, f. 10.

Cast up, Streaky Bay.

Ovate-subtrigonal, with fourteen broadish radiating costæ; about one-fourth inch long.

Family Unionidæ.

120. Unio Stuarti, A. Adams and Angas (*Alasmodon*), P. Z. S., 1863, p. 417; *Anodon Stuarti*, Sowerby, in Reeve, Mon., t. 34, f. 136, 1870.

Various freshwater streams in the Lake Eyre Basin, as at Mount Margaret! the type locality (*Waterhouse*); at Umbum, 40 miles south from Peake!; Cooper's Creek, at Innamincka! Also Newcastle Waters (*Waterhouse!*)

An elongate-ovate shell, about twice as long as wide; posterior side long, obliquely subtruncate; hinge line straight. Length, four inches.

121. Unio Evansi, A. Adams and Angas (*Alasmodon*), P. Z. S., 1864, p. 39; id., Reeve, Mon., t. 56, f. 285, 1867.

In the actual bed of the River Murray, and therefore apparently rare, I have taken it several times from the stomach of the "Murray cod."

A thick elongate-ovate shell, about twice as long as wide, with the dorsal line arched, attenuated and somewhat angulated posteriorly. Length, four inches.

122. Unio depressus, Lamarck, Ans. s. Vert., vii., p. 79; *U. mutabilis*, Lea, Obs. on Unio, vii., p. 66, t. 38, f. 167.

Very abundant in the lagoons bordering the River Murray and in Lake Alexandrina; also New South Wales.

Quadrately-ovate, nearly as broad as long, thin, depressed; hinge line nearly straight, short; truncated posteriorly. Length, from two to three inches.

123. Unio vittatus, Lea, Obs. on Unio, vii., p. 67, t. 39, f. 128; *U. ambiguus*, Philippi.

Rivers Para, Torrens, and Onkaparinga; Scott's Creek, a tributary of the R. Bremer; Mosquito Creek, near Narracoorte; also Queensland.

Ovate-oblong, somewhat thick and inflated; dorsal line arched, somewhat ascending posteriorly; posterior margin roundly truncated. Length, about three inches; breadth, two inches.

Family Trigoniidæ.

124. Trigonia margaritacea, Lamarck, An. s. Vert, vi., p. 63; Reeve, Mon., t. 1, f. 3.

Dead shells, Holdfast and Aldinga Bays. Dredged in life

from eight fathoms in Encounter Bay (*R. H. Pulleine!*); also Tasmania (type) and New South Wales.

Family Nuculidæ.

125. Nucula micans, Angas, Proc. Zool. Soc., 1878, t. 54, f. 16.

Shell sand, St. Vincent Gulf.

A minute shell, obliquely and triangularly ovate, finely concentrically striated.

126. Leda crassa, Hinds., P. Z. S., 1843, p. 99; id. Reeve's Mon., t. 5, f. 27. *L. Chuva*, Gray in Jukes, Voy. Fly, ii., t. 2, f. 3, p. 360 (1847); id. Reeve, Mon., t. 7, f. 46.

Rare in St. Vincent Gulf, but common as a beach shell in Encounter Bay, dredged in life from deep water by R. H. Pulleine. Extends to Queensland. Gray's types are from Bass Straits.

Elongate oval, ventral margin strongly arched, curved upwards posteriorly to form a rostral prolongation, sculptured with thick flattened ribs.

Family Arcidæ.

127. Arca navicularis, Bruguiere, Reeve's Mon., t. 9, f. 70.

Port Augusta, Spencer Gulf (*R. H. Pulleine!*). Also Victoria (E. A. Smith); Queensland and North Australia!, China and Amboina.

Elongate, trapeziform, umbones high and wide apart, gaping ventrally, ornamented with granular ribs with unequal thick radial ribs on the posterior slope, attaining to one and a half inches long.

128. Barbatia lima, Reeve (*Arca*), P. Z. S., 1844; id. Mon., t. 15, f. 101.

Deep water, St. Vincent Gulf (*Angas*). Also Torres Straits (Voy. Challenger), and Philippines.

129. Barbatia radula, E. A. Smith, Moll. Challenger Exped., t. 17, f. 3, p. 260.

General from the Great Australian Bight to the South-East coast. Also Victoria and Tasmania.

Narrowly oblong, inequilateral, ornamented with numerous slender granulated ribs, and clothed with a brown pilose epidermis, attaining to a length of two inches.

130. Barbatia trapezia, Deshayes (*Arca*), Mag. de Zool.; *Arca lobata*, Reeve, P. Z. S., 1844, and Mon., t. 3, f. 19.

In a subfossil condition at Wallaroo Bay, Victor Harbour, Ardrossan, Aldinga Bay, and Port Adelaide Creek; dead, but

apparently fresh, shells on the beach at Streaky Bay, Great Australian Bight. Also Victoria, Tasmania, and New South Wales.

It is one of the most characteristic fossils of the raised beaches along our coastline.

Trapeziform, oblique, gibbous, very thick; radial costæ, rather distant and crenulated; length, two inches.

131. Barbatia laminata, Angas, Proc. Zool. Soc., 1865.

At several stations in the Great Australian Bight and St. Vincent Gulf.

Oblong, about one inch long and half an inch wide, concentric lamellæ imbricating and frilled.

132. Pectunculus radians, Lamarck, An. s. Vert., vi., p. 54.

Port Lincoln; Encounter Bay; South-East coast (*W. T. Bednall!*). Also Victoria, Tasmania, and New Holland (*Lamarck*).

Orbicular, with flattish, radial ridges, radially substriated and concentrically finely striated.

133. Pectunculus obliquus, Reeve, P. Z. S., 1843.

Fowler's Bay, St. Vincent and Spencer Gulfs; South-East coast. Also West Australia (type) and Tasmania.

Suborbicular, inequilateral, produced posteriorly, ornament similar to the last, but the radial ridges more elevated and acute; length, to one inch and a quarter.

134. Pectunculus flabellatus, Tenison-Woods, Trans. Roy. Soc., Victoria, xiv., p. 61, 1878; *P. orbicularis*, Angas, P. Z. S., 1879, t. 35, f. 9; *P. Beddomei*, E. A. Smith, Moll. Challenger Expedition., t. 18, f. 1, p. 252.

Dead shells, Hallett's Cove; Ardrossan; Cape Jervis; Wallaroo. Also Victoria and Tasmania (*T. Woods*); Flinders Island (*R. M. Johnston!*); Bass Straits (*Angas; Challenger Exped.*).

Orbicular, thick, with about 25 broad, somewhat depressed radial ribs; colour white, more or less clouded and spotted with fulvous-brown.

135. Pectunculus Grayanus, Dunker, Proc. Zool. Soc., 1856, p. 357.

Wallaroo (*Dr Gosse!* and *R. T.*) Also New South Wales.

A thick orbicular shell, smooth, white, with angular streaks and flames of chesnut-brown colour; about two inches in diameter.

135. Limopsis Bassii, E. A. Smith, Moll. Challenger Exped., t. 18, f. 6, p. 256, 1885.

Dredged in life from 20 fathoms in Encounter Bay (*R. H. Pulleine!*); cast up at Ardrossan and Edithburg. Also Bass Straits in 38 fathoms (*Challenger Exped.*).

Transversely ovate, oblique, cancellate ornament, reddish-brown, dirty-white or yellowish about the umbos, clothed with a thick pilose epidermis; length, three-fourths inch.

137. Limopsis Belcheri, Adams and Reeve, Voy. Samarang, t. 22, f. 5; id. McCoy, Pal. Victoria, Decade II., t. 19, figs. 8–9; *L Tenisoni*, Tenison-Woods, Proc. Roy. Soc., Tasm., 1877; *L. cancellata*, id. 1876 (non. *Reeve*); *L. Macgillivrayi*, Angas, P. Z. S., 1878, p. 871.

Robe and Guichen Bays in a fresh state; dead shells St. Vincent Gulf and Kangaroo Island. Also Port Phillip (*McCoy*); Tasmania (*Tenison-Woods*).

A common fossil in the Pleistocene beds of the Port Adelaide Creek, and in Older Tertiary beds River Murray Cliffs, Muddy Creek near Hamilton, &c.

Orbicular, slightly oblique; radiately ribbed and with wavy, close, concentric liræ; the ligamental pit is much smaller and the hinge teeth (about 24) more numerous than in *L. Bassii.*

138. Limopsis rubricata, Tate, *anteà*, p. 71, t. 5, f. 6.

Dredged in life from 32 fathoms, Backstairs Passage.

A minute shell, radiately finely sulcated, concentrically striate, with four chesnut-coloured rays, covered with a thin light-horn epidermis.

FAMILY MYTILIDÆ.

Genus Mytilus.

(a) *With longitudinal furrows.*

139. Mytilus hirsutus, Lamarck, An. s. Vert., vi., p. 120; id., Reeve, Mon., t. 3, f. 8.

At various stations from the Great Bight to Port Lincoln; Port Broughton and Wallaroo; Kangaroo Island; Port Adelaide Creek; also Tasmania, New South Wales, Japan, and China.

Strongly curvated; dark brown, ornamented with very fine closely-set dichotomous riblets, and covered with long, barbed hairs. Length, two and a-half inches.

140. Mytilus rostratus, Dunker, Proc. Zool. Soc., 1856 p. 358.

Great Australian Bight; Edithburg; Encounter and Guichen Bays; also Tasmania (type).

Elongate, nearly parallel sided, attenuated towards the beaks; reddish-purple, ornamented with fine closely-set divaricating riblets. Attains to one and a-half inches long.

141. Mytilus Menkeanus, Philippi.

Throughout the South Australian coast line, on rocks between tide marks; also King George Sound!

Variable in shape, usually strongly curvated, with uncinate beaks, but sometimes elongated with nearly straight sides, ornamented with a variable number of radial undulating thick granulose ribs; colour, brown outside, purplish within. Length, about one and a-half inches. It is separable from *M. Magellanicus*, Lamarck.

(b) *Surface smooth.*

142. Mytilus ater, Frauenfeld, Moll. Novara Exped., t. 2, f. 29, 30; *M. crassus*, Tenison Woods, P. R. S. Tasmania for 1876, p. 157.

Rocky shores between tide marks, St. Vincent Gulf; also Tasmania (*T. Woods*) and New Zealand! (*Novara Exped.*, *Hutton*, &c.).

Oblong, black, with very tumid umbones. Length, about one inch.

143. Mytilus chorus, Molina; *M. latus*, Lamarck, An. s. Vert., vi., p. 122 (*non.* Chemnitz).

On the keel of the hulk Fitzjames moored in Largs Bay (*Port Adelaide Mus.!*). Probably introduced to this locality from Port Phillip!, where the species is common, and where also the hulk was a derelict for several years; Guichen Bay (*R. H. Pulleine!*); also Tasmania, New Zealand, and Chili.

Oblong-oval, dilated and compressed behind, covered with a dark olive-brown shining epidermis, with a few scattered long hairs set in a white calcareous disc, interior bluish-white; attaining to four inches long.

144. Modiola australis, Gray in King's Coasts of Australia, ii., p. 477, 1827; id. Reeve, Mon., t. 5, f. 21. *M. tulipa*, *var.*, Lamarck, An. s. Vert., vi., p. 111, 1819. *M. areolata*, Gould, U. S. Ex. Ep. xii., p. 452, f. 562.

Beyond low tide throughout South Australian waters. Also Tasmania, New South Wales, and New Zealand. New Holland (*Lamarck*).

Ovately oblong, anterior side very short, posteriorly broadly dilated, convex in the middle; yellow chesnut; adult shells bearded towards the margin; length to three inches.

145. Modiola albicosta, Lamarck, An. s. Vert., vi., p. 111.

Port Elliot (*W. T. Bednall!*). Also Tasmania (*T Woods*), Timor, Indian Ocean, and New Holland (*Lamarck*).

Smooth, shining, dark chesnut with darker rays; attaining to two and a half inches.

146. Modiola semivestita, Dunker, Mal. Bl. xviii., p. 173, 1871. *Perna flavida*, Angas, P. Z. S., 1865, p. 653 (*non* Dunker). Plate 5, figs. 16*a*—16*b*.

Nesting in mud between tide-marks, Port Adelaide Creek, and elsewhere in St. Vincent Gulf; Laura Bay on the west coast. Also King George Sound!, St. Vincent Gulf (*Dunker*).

Narrowly oblong, with a chesnut-brown shining epidermis, folds of growth conspicuously raised; length three-quarters of an inch.

I fail to recognise the woolly investiture which Dunker describes as clothing the shell, and think the author has mistaken for it the raised epidermal laminæ encrusted with the foreign matter of its burrow.

147. Modiolaria barbata, Reeve, Mon. Lithodomus, t. 5, f. 27; *Lithodomus laniger*, Reeve, op. cit., f. 30; *Modiolaria barbata*, Angas, P. Z. S., 1867, t. 44, f. 12, p. 911.

Streaky, Fowler, Aldinga, and Holdfast Bays. Also New South Wales (type).

Oblong-ovate, with the epidermis long thick and fibrous posteriorly; length about half an inch.

148. Modiolaria Cumingiana, Reeve, Mon. Modiola, t. 9, f. 63, 1857; *Lanistina nana*, Dunker, P. Z. S., 1856, p. 365; *Modiola nana*, Reeve, Mon., t. 10, f. 69; *Crenella* (*Modiolaria*) *Adolphi*, Dunker, Mal., xviii., p. 173, 1871.

Throughout South Australia, living on sponges, and amidst the parasitic growth on oysters and pinnæ. Extends around the east coast to Port Darwin.

Oblong-oval, inflated; colour, brown, yellow, or in the young stage green mixed with brown. Attaining to a length of one inch.

Lanistina nana, founded on specimens in the Cumingian collection from Port Lincoln, is evidently the fry of *M. Cumingiana*; the rufous variegation and pellucidity which charaterises the early stage of growth are lost in aged examples.

Crenella Adolphi, of the same author, the type of which is from St. Vincent Gulf, seems in no way to differ, so far as description admits of forming an opinion, from *M. Cumingiana*.

149. Modiolaria Paulucciæ, Crosse and Fischer (*Crenella*), Journ. de Conchy., 1863, p. 89, t. 1, f. 8.

Among Zosteræ, Fowler, Denial, and Laura Bays, on the west coast; Spencer and St. Vincent Gulfs.

Oblong-ovate, depressed; broad posteriorly, there ornamented with broad, distant radial ribs; varying in colour from yellow, brown, to bright green, sometimes painted with undulose purplish-brown markings. Length, half an inch.

150. Malleus vulsellatus, Lamarck, An. s. Vert, vi., p. 145; *M. albus*, Lamarck; *M. normalis*, Lamk.; *Ostrea regula*, Forskal.

Buried in sand in a few fathoms water, St. Vincent Gulf; Port Lincoln; dead shells, Fowler's Bay, Wallaroo Bay; widely diffused in Australia; Timor, China, &c., to the Red Sea.

151. Pinna inermis, Tate, *anteà*, p. 71, t. 4, f. 5; *P. Zeylanica*, Angas, P. Z. S., 1865, p. 655 (*non* Gray).

Partially buried vertically in mud or sand in a few fathoms water, St. Vincent Gulf, and general from Eucla to the South-East coast.

This shell, locally known as "razor-fish," is wedge shaped, somewhat roundly acuminate posteriorly, and otherwise differs from *P. Zeylanica* by the absence of scaly ribs. Attains to a length of about eighteen inches.

152. Vulsella ovata, Lamarck, An. s. Vert., vi., p. 222; *V. Tasmanica*, *V. limæformis*, and *V. rudis*, all of Reeve, Mon. Vulsella.

Immersed in sponge from shallow water to 32 fathoms; common throughout the whole coast line; also West Australia, Tasmania, and New South Wales.

Very variable in shape, pale horn coloured; concentric liræ, fringed with minute flattened scales.

153. Avicula Georgiana, Quoy and Gaimard, Zool. Voyage Astrolabe, vol. 3, p. 457, t. 77, f. 10–11, 1835; *A. scalpta*, *A. pulchella*, *A. rutila*, and *A. punctulata*, all of Reeve, Mon. Avicula. Possibly *A. papilionacea*, Chemnitz.

Affixed to seaweed. Very general. Extends from King George Sound (*Quoy* and *Gaimard*) to New South Wales. Locally called "butterfly shells."

The above-quoted species-names of Reeve have been founded on individual variations in colour and colour markings.

Transparent, varying in colour from pellucid white, brown, green, with or without coloured rays or spots; length, about one inch.

154. Meleagrina margaritifera, Linnæus (*Mytilus*), Syst. Nat.; Lamarck, An. s. Vert. vi., p. 151.

"Deep water, Spencer Gulf, Coffin Bay, and the Great Australian Bight. This is the 'pearl oyster,' a species generally distributed throughout the Indo-Pacific marine molluscan province" (*Angas*). A very rare species, I have seen only one South Australian example, and that young, in the cabinet of Mr. Bednall.

FAMILY PECTINIDÆ.

155. PECTEN ASPERRIMUS, Lamarck, An. s. Vert., vi., p. 174; id. Reeve, Mon. Pecten., t. 20, f. 5; *P. australis*, Sowerby, Thes. Conch., p. 76; id. Reeve, t. 25, f. 103.

On a soft bottom, at a depth of a few fathoms. Throughout the whole length of our coastline. Also West Australia (*Sowerby*), Tasmania (*Lamarck*), New South Wales, New Zealand, and Gulf of Suez (Vaillant, *J. de Conchyl.*, 1865, p. 112).

About 30 radial ribs, flanked on each side by a smaller one, all studded with small spinous scales; colour yellow, orange, brown, scarlet, or purplish; about two inches diameter.

156. PECTEN PULLEINEANUS, Tate, *anteà*, p. 73, t. 4, figs. 1*a–b*.

South-East coast (*R. H. Pulleine!*)

Thirty-three simple similar ribs crossed by close-set continuous lamellæ; about one inch diameter.

157. PECTEN BEDNALLI, Tate, *anteà*, p. 73, t. 4, figs. 3*a–b*.

Aldinga Bay (*W. T. Bednall!*).

Twenty-four groups of two or three subequal ribs with quincuncially-arranged depressions in the interspaces; about one inch diameter.

158. PECTEN BIFRONS, Lamarck, An. s. Vert., vi., p. 164; id. Reeve, Mon., t. 12, f. 45.

Inhabits at about two to six fathoms, and occurs throughout our coast-line reaching to Tasmania. New Holland (*Lamarck*).

Depressed, slightly inequivalve and inequilateral, with about seven principal ribs and numerous radial riblets, with a shagreen-like sculpture between them; attaining a diameter of about three inches.

159. PECTEN FUMATUS, Reeve, Mon. Pecten, t. 7, f. 32. VAR. ALBUS, Tate, Proc. Roy. Soc., Tasm., 1886.

Syn.:—*Vola laticostata*, Angas, P. Z. S., 1865, p. 656 (*non.* Gray); *Pecten bifidus*, Menke, Moll. Nov. Holl., p. 35, 1843; id. Philippi, Neu. Conch., Vol. 1, p. 6, t. 2, f. 6, 1845 (*non.* Münster).

Inhabits with the last extending from Fowler Bay to Port Lincoln and St. Vincent Gulf. Menke's shell is from West Australia.

Right valve deeply convex, sixteen convex ribs about as wide as the furrows, white inside and out; left valve flat, whitish with pink ribs; attaining to a diameter of three and a half inches.

160. LIMA MULTICOSTATA, Sowerby, Thes. Conch.; id. Reeve, Mon., t. 1, f. 4; *Radula lima* (Linne), Angas, P. Z. S., 1865, p. 656.

Chiefly in sponge at shallow depths; Great Australian Bight to Port Lincoln, Spencer and St. Vincent Gulfs, Guichen Bay. Throughout Australia and the Indo-Pacific region.

Oblique, with about 30 scaly ribs; attaining to two inches in the longer diameter.

161. Lima angulata, Sowerby, Thes. Conch., p. 86, t. 22, f. 39; id. Reeve, Mon., t. 3, f. 13.

Living at two to six fathoms in St. Vincent Gulf and at Port Lincoln. Also New South Wales, New Zealand, New Caledonia, Philippines, and Panama.

Obliquely subtrigonal, ventricose, very finely radiately ribbed; attaining to nearly one inch in the longer diameter.

162. Lima bullata, Born; id. Reeve, Mon., t. 1, f. 2; *L. Strangei*, Reeve, Mon., t. 3, f. 15; *L. Japonica*, A. Adams, P. Z. S., 1863, p. 509; Reeve, Mon., t. 5, f. 21.

Wauraltee Island and Wallaroo in Spencer Gulf, St. Vincent Gulf, Guichen Bay. Also Tasmania, New South Wales, and Queensland, extending to New Zealand, the Philippines, and Japan.

This species belongs to the section Limatula, having equilateral, ovate valves; rayed with numerous strong, rather sharp ribs. Attaining to about one and a-quarter inch in the longer diameter.

163. Limea austrina, Tate, *anteà*, p. 73, t. 4, f. 7.

Dead shells dredged in 32 fathoms in Backstairs Passage, and in 22 fathoms in Encounter Bay; also in Pliocene strata, Limestone Creek, R. Glenelg, Victoria.

A small subovate, equilateral shell, ornamented with twenty radiating nodulose ribs.

Family Spondyliidæ.

164. Spondylus tenellus, Reeve, Mon., t. 18, f. 67.

Not uncommon from Eucla to Port Lincoln, St. Vincent and Spencer Gulfs; Guichen Bay; also in Tasmania and in the Pacific.

Ovate, radiately ridged, bearing foliaceous or spinous expansions, the interspaces with crowded radial riblets, covered with imbricating scales. Length, two inches.

Family Anomiidæ.

165. Placunanomia Ione, Gray, Proc. Zool. Soc., 1849, p. 123; id., Reeve, Mon., t. 2, f. 6; Tate, T. R. Soc. S. Aust, 1885, t. 5, f. 7, p. 101.

Not uncommon in St. Vincent Gulf, affixed to Pinnæ; cast

up South-East coast; also Tasmania, New South Wales, and New Zealand. Upper beds of the Older Tertiary, River Murray cliffs, at Aldinga and Hamilton; Pliocene beds at Limestone Creek, R. Glenelg.

Irregularly orbicular, flat, thin, ornamented with imbricating scaly laminæ, and radial threads or ridges; diameter, two inches.

FAMILY OSTREIDÆ.

166. OSTREA ANGASI, Sowerby, in Reeve's Mon., t. 13, f. 27.

Ranges from low tide to a few fathoms; Davenport Creek, in the Great Bight; Coffin's Bay and Port Lincoln; Spencer and St. Vincent Gulf; Kangaroo Island; also Tasmania, New South Wales, Port Darwin, and New Zealand. In Pliocene strata, Limestone Creek, and Ascot Heath, in West Victoria.

This species, which is the common "Port Lincoln oyster" of the Adelaide markets, is the southern analogue of the European *O. edulis*, under which species name, or as a variety, it has been more frequently quoted by conchological writers. The "Sydney rock-oyster" (*O. glomerata*, Gould), so largely imported as food, is not indigenous in our waters, but it has lately been introduced, so I have been informed, to the Port Lincoln district.

CLASS PALLIOBRANCHIATA.

1. WALDHEMIA FLAVESCENS, Lamarck, An. s. Vert., [vi., p. 246; Reeve, Mon. Terebratula, t. 2, f. 1.

Attached to rocks and the bases of the large seaweeds beyond low tide, Fowler Bay, St. Vincent and Spencer Gulfs, Encounter Bay. Also Victoria, Tasmania, and New South Wales.

Ovate, inflated, with a pentagonal outline and broad radial ridges; length, one inch.

2. TEREBRATELLA CANCELLATA, Koch.

Dredged in life from 32 fathoms in Backstairs Passage; dead shells from 20 fathoms, Encounter Bay (*R. H. Pulleine!*) Also New South Wales (*Brazier*), West Australia (*Dall*), and Tasmania (*Challenger Exped.*).

Shell ovate, rather depressed, with a pentagonal outline, ornamented with numerous radiating riblets; length, three-fourths of an inch.

3. MEGERLIA WILLEMOESI, Davidson, Brach. Challenger Exped., t. 4, f. 1–3, p. 51.

One dead shell from 22 fathoms in Encounter Bay (*R. H. Pulleine!*)

A minute, inflated, smooth, ovate shell of a cochineal-red

colour. The identification is not complete, as the example has lost its loop: it is certainly not *Magasella Cumingi*. The type is from Twofold Bay, New South Wales.

4. Kraussina Lamarckiana, Davidson, P. Z. S., 1852, p. 80, t. 14, f. 22–33; id. Reeve, Mon. Terebratula, t. 9, f. 34.

Shell sand, Fowler's and Holdfast Bay. Also New Zealand, Tasmania, and New South Wales.

Shell very small, squarely rounded, depressed, radiately ridged, conspicuous by its straight hinge line and its large broadly-triangular foramen.

5. Orbicula tenuis, Sowerby, in Reeve's Mon., t. 1, f. 5.

Port Lincoln and Chili (Cuming Coll.).

Description of a supposed New Species of Phasmidæ.

By J. G. O. Tepper, F.L.S., &c.

[Read August 3, 1886.]

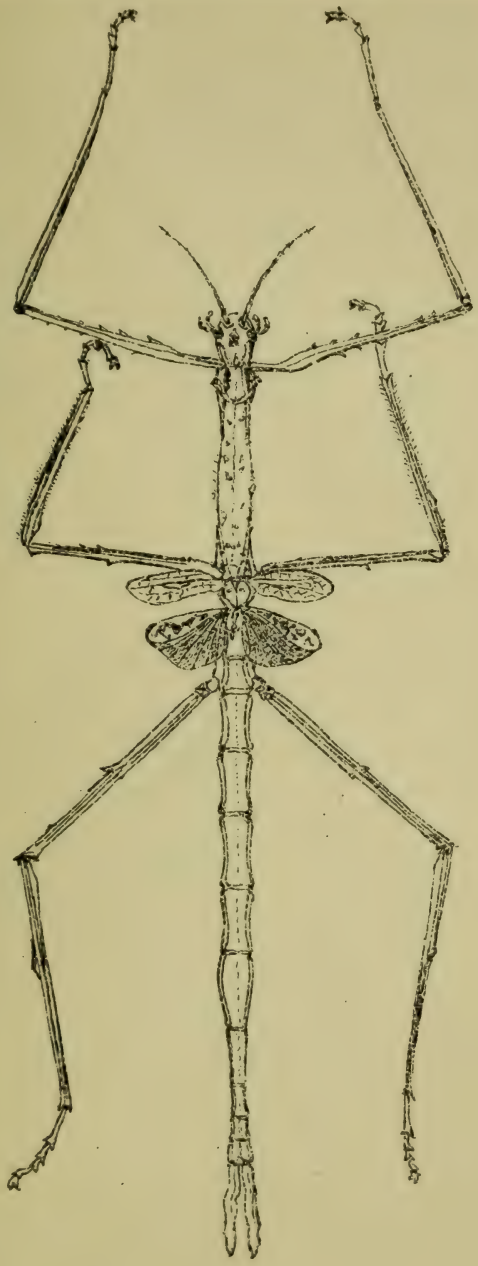
Plate VI.

Several very remarkable examples of Phasmidæ with rudimentary wings were presented in the course of the last twelve months to the Adelaide Museum. The perfect insect was captured at Mount Lofty by Mrs. Stirling, and another specimen was obtained by Mr. Guest, of Balhannah, while I collected two specimens in the nymphal condition.

In consulting the available literature I could find no mention of this large insect. I therefore venture to lay a description before the Society, and attach a provisional name, deferring the species to Westwood's genus *Lopaphus*, although one of the generic distinctions does not fit, viz., "tegmina much smaller than the wings." The one before us has the first as long or longer than the latter.

Lopaphus macrotegmus. *Spec. nov.* Plate VI. (nat. size of a rather small specimen).

Body long, slender, dull brown, similarly winged in both sexes; head elongated, broader in front, forehead slightly wrinkled; eyes prominent; antennæ filiform, first two joints dilated, many-jointed, about four or five times the length of the head; mesothorax five times longer than the prothorax, with a few small tubercles; metathorax about half as long; abdomen cylindrical, tapering after fourth segment, last two very short; terminal foliolets longer than any segment, rather broad, rounded at the tip; operculum conspicuous, rising from seventh segment, not extending beyond the body; legs straight, slender, mottled grey, first pair longest; femora dentated conspicuously above, less so beneath, inner angle smooth; tibia straight, smooth; second pair shortest; femora with one (or two) teeth above near the middle, four or five beneath; tibia twin tooth above, nearer the elbow joint, and two small teeth near the wrist beneath; third pair intermediate; femora one small tooth in the middle and another near elbow above and several beneath, tibia with a double tooth above; tarsi long, first joint longer than half the



W.J.CHIOLEY DEL.

whole, fourth very small; tegmina as long or longer than the wings; the latter rudimentary, anterior part pale brown with a few irregular narrow black bars; posterior part black, translucent. Length of body, about $5\frac{1}{2}$ in.; head, about $\frac{1}{4}$ in.; forelegs, about $3\frac{3}{4}$ in.; middle pair, about $2\frac{3}{4}$ in.; tegmina, about $\frac{5}{8}$ in.; wings, about $\frac{4}{7}$ in.; foliolets, about $\frac{5}{8}$ in. The above refers to the female, the male being slightly smaller. In the nymphal form the colour is greenish, but the dentation of the legs, notably the teeth on the upper edge, quite identical with those of the perfect form in all my specimens. The size is also less—from $3\frac{3}{4}$ to $4\frac{3}{4}$ in.., and the body more slender.

The eggs are elliptic, cylindrical, about one-eighth inch long and half as thick, wrinkled, greyish black when mature, and open with a lid at one end, which bears a conspicuous round knob.

They live upon stringybark shrubs in the Mount Lofty Ranges.

Additions to the Flora of Kangaroo Island.

By J. G. O. Tepper, F.L.S., &c.

[Read September 7, 1886.]

Being attached to an exploring party under the leadership of Mr. J. E. Brown, the Conservator of Forests, and Mr. A. Molineux, for the purpose of collecting for the Museum, I availed myself of the opportunity of making some observations on the flora of the island.

Starting from Queenscliffe on the 25th of February last, the track along the telegraph line to Cape Borda was generally followed, passing in succession Kinch's Station on the South Western River, Digger's Camp, Rocky and Grassy Creeks, the Head of the South Western River, Ravine des Casoars, Harvey's Return, and reached Cape Borda on the 1st of March. A day was spent at Harvey's Return, after which the Head of the South Western River was again visited, but from thence a detour made to Karatta Station, near the mouth of the Stunsailboom River on the south coast of the island, from thence returning by the Eleanor River, Mount Pleasant Station, Birchmore's Lagoon to the South Western River, a mile or two west of the bridge, on the 7th of March. On the route some 200 species of plants were gathered, but many as yet undetermined, notably most of the Rhamneæ, many being imperfect on account of the lateness of the season.

The following species and varieties are new for the flora of the island; those marked with an asterisk also new for the province:—

RANUNCULACEÆ.

Ranunculus rivularis, *Banks & Sol.* Ravine des Casoars.

RUTACEÆ.

Boronia Edwardsii, *Benth.* Head of South Western River.

Correa æmula, *F. v. M.* Head of the South Western. Hitherto very rare, peculiar to South Australia.

SAPINDACEÆ.

Dodonæa bursarifolia, *Beer.* Ravine des Casoars.

LEGUMINOSÆ.

Pultenæa daphnoides, *Sonder.* Head of South Western.

*Pultenæa scabra, *R. Br.* Head of South Western.

Acacia myrtifolia, *Willd.*, variety angustifolia, *F. v. M.* Very common in the form of low dense shrubs of three to five feet, between Grassy Creek and the Ravine des Casoars.

*Acacia Whanii, *F. v. M.* A few shrubs seen on the banks of a dry creek south-west of Birchmore's Lagoon.

SAXIFRAGEÆ.

Bauera rubioides, *Andr.* Grassy and other creeks, and at the head of the South Western.

HALORAGEÆ.

Loudonio aurea, *Lindley.* Banks of a lagoon south of the head of the South Western.

MYRTACEÆ.

Eucalyptus Sieberiana, *F. v. M.* Harvey's Return.

RHAMNACEÆ.

Cryptandra hispidula, *Reiss.* Digger's Camp.

OLACINEÆ.

Olax Benthamiana, *Miquel.* Scrubland near Cape Borda. An additional family to this flora.

PROTEACEÆ.

Grevillea pauciflora, *R. Br.* Head of the South Western.
Hakea ulicina, *R. Br.*; var. carinata, *F. v. M.* Cape Borda.

GENTIANEÆ.

Limnanthemum sp. Ravine des Casoars.

ASPERIFOLIÆ.

Halgania lavandulacea, *Endl.* Head of the South Western.

EPACRIDEÆ.

Styphelia hirtella, *F. v. M.* Scrublands, Mount Pleasant.
Styphelia serrulata, *Lab.* (var.) Head of South Western, &c.

FLUVIALES.

Lepilæna Preissii, *F. v. M.* Karatta.

RESTIACEÆ.

Leptocarpus tenax, *R. Br.* Birchmore's Lagoon.

JUNCEÆ.

Juncus cæspitius, *E. Meyer.* Ravine des Casoars.

CYPERACEÆ.

*Schœnus fluitans, *J. Hooker.* Head of South Western.
Schœnus capillaris, *F. v. M.* Head of South Western.
Cladium tetraquetrum, *Hooker.* Head of South Western.
Lepidosperma carphoides, *F. v. M.* Mount Pleasant.

FILICES.

Schizæa fistulosa, *Labill.* Head of South Western.

Trochidæ and other Genera of South Australia, with their Synonyms.

PART I.

By John Brazier, F.L.S., C.M.Z.S., &c.

[Read October 5, 1886.]

1. Trochus (Cantharidus) Lesueuri, *Fischer*, sp.

1822. *Phasianella elegans*, Lam., Anim. sans Vert., vol. 7, p. 53, No. 4.

1843. *Phasianella elegans*, Lam., 2nd edit. (Deshayes), vol. 9, p. 243.

**Trochus elegans*, Kiener Genus Trochus, Coq. Vivantes, pl. 4, 5, fig. 2 (non *Trochus elegans*, Gmelin).

1843. *Trochus Lehmanni*, Menke, Moll. Novæ Hollandiæ, p. 18, No. 70 (non *Trochus Lehmanni*, Kiener).

1845. *Trochus Lehmanni*, Menke; Philippi in Abbild Besch neuer Conch., vol. 2, heft 2, p. 37, pl. 7. *Trochus*, fig. 2 (non *Trochus Lehmanni*, Kiener).

1845. *Trochus Lehmanni*, Menke; Catlow and Reeve, Conchologists' Nomenclator, p. 217, No. 75.

†1849. *Trochus pictus*, Philippi in Conch. Cab., 2nd edition, p. 139, No. 166, pl. 23, figs. 18-19 (non *Trochus pictus*, Wood).

1851. *Thalotia Lehmanni*, A. Adams, Proc. Zool. Soc., p. 172, No. 4.

1873. *Thalotia Lehmanni*, Paetel, Catalog. der Conch.-Sammlung, p. 73.

1877. *Thalotia picta*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41.

1880. *Trochus Lesueuri*, Fischer; in Kiener Coq. Vivantes, p. 129-420.

Hab.—Coast of Australia (*Peron and Lesueur*); St. Vincent's Gulf, South Australia (*G. F. Angas*, *W. Bednall*, *Professor Tate*); Swan River (*Priess*); Cape Riche, King George's Sound

---

* The date of publication of Kiener "Spécies général et Iconographie des Coquilles Vivantes" is not given. The date is given in that edited by Dr. Fischer.

† The title-page of the genus Trochus in the Conchylien Cabinet is missing in the copy in the Australian Museum. I have only been able to find that the work must have been published about the year 1849-50.

(*Brazier*); Fowler's Bay and Encounter Bay (*Tate*); North Tasmania (*Tenison-Woods*),

This species was described first by Lamarck as *Phasianella elegans*, and placed by Kiener in the genus Trochus in his Coquilles Vivantes. It is not the *Trochus elegans* of Gmelin, which is the *Trochus purpuratus* of Martyn. *T. elegans* is the *T. Lehmanni*, Menke, and the *Trochus pictus*, Philippi, not of Wood. Dr. Fischer points out in Kiener, page 129, that the figure of *Trochus pictus*, Wood, is very doubtful, and a new specific name being required for Kiener's, he renames it *Trochus Lesueuri*, Fischer. This is the same species that is quoted by the Rev. Tenison-Woods and Mr. Angas as the *Trochus pictus*, Wood.

2. Trochus (Thalotia) conicus, *Gray*, sp.,

1827. *Monodonta conica*, Gray in Captain King's Survey of Australia, Appendix; vol. 2, p. 479, No. 28.

1828. *Trochus pictus*, Wood, Index Testaceologicus, Suppliment, p. 17, pl. 5, Trochus fig. 28.

* *Trochus Lehmanni*, Kiener, Coq. Vivantes Genus Trochus, pl. 46, fig. 2-2a, (non *Trochus Lehmanni*, Menke).

1843. *Monodonta turrita*, Menke, Moll. Novæ Hollandiæ, p. 15, No. 57.

†1849. *Trochus conicus*, Gray; Philippi in Conchylien Cabinet, 2nd edition, p. 130, No. 150, pl. 23, fig. 1.

1849. *Trochus turritus* (Monodonta), Menke=*conicus*, Gray, Philippi in Conch. Cabinet, p. 372, index.

1851. *Thalotia picta*, A. Adams, Proc. Zool. Soc., London, p. 172, No. 1.

1854. *Thalotia conica*, Gray; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420, pl. 48, fig. 1.

1854. *Trochus Lehmanni*, Hombron and Jacquinot Voyage au Pôle-Sud (Zoologie), vol. 5, p. 54; Atlas plates, Mollusca, pl. 14, fig. 7-8 (non *Trochus Lehmanni*, Menke.

1854. *Thalotia picta*, H. and A. Adams, Genera of Recent Mollusca, vol. i., p. 420.

1856. *Trochus pictus*, Wood, Index Test Suppliment (Hanley's edition), p. 220, pl. v., Trochus, fig. 28.

1859. *Trochus* (*Thalotia*) *Lehmanni*, Chenu, Manual de Conch., t. 1, p. 359, fig. 2,659 (non *Trochus Lehmanni*, Menke).

1865. *Thalotia picta*, Angas (as of Wood), Molluscan Fauna of South Australia, Proc. Zool. Soc., London, p. 179, No. 148.

1873. *Thalotia conica* (Sowerby!!), Paetel, Catalog der Conch.-Sammlung, p. 73.

1877. *Thalotia picta*, Tenison-Woods (as of Wood), Papers and Proc. Royal Soc., Tasmania, p. 41.

1880. *Trochus conicus*, Fischer, in Kiener Coq. Vivant, p. 135.

1881. *Monodonta turrita*, Menke=*Thalotia conica*, Gray ; Tate, Proc. Linn. Soc., N.S.W., vol. 6, p. 394.

Hab.—King's Island, Bass Straits (*Peron* and *Lesueur*); New Holland (*Captain King*); St. Vincent Gulf, South Australia (*G. F. Angas*, *W. T. Bednall*); Bass Straits and North-East Tasmania (*Tenison-Woods*, *W. F. Pettard*); Kangaroo Island (*Tate*).

There has been great confusion in reference to this species. It was first of all described by Dr. J. E. Gray as *Monodonta conica* in 1827. In 1828 it is figured and called *Trochus pictus* by Gray or Wood in the Index Testaceologicus. If any naturalist will only examine the figure well in the Index Test : he will at once see the figure shows three small denticulations on the columellar. A number of specimens of the slender form I have from St. Vincent Gulf are true to Wood's fig. in Index Test. Philippi, in the Conchylien Cabinet, makes *Trochus Lehmanni*, Menke, a synonym of *Trochus pictus*, Wood. The *Trochus Lehmanni*, Menke, is the *Trochus Lesueuri*, Fischer, described by Lamarck as *Phasianella elegans*. Kiener also calls it *Trochus Lehmanni*. A. Adams in 1851 comes much nearer than any previous authors, for he quotes it as *Thalotia picta*, Wood, Proc. Zool. Soc., London, and makes *Monodonta turrita*, Menke, its synonym. Philippi, in the Index to the Conchylien Cabinet, quotes Menke's *turritus* as the synonym of *Trochus conicus*, Gray. In 1854 Hombron and Jacquinot give splendid figures of it in the Voyage au Pôle-Sud as *Trochus Lehmanni*. Chenu also figures it as *Trochus Lehmanni*, but it is not the *Trochus Lehmanni* of Menke. Mr. Angas quotes this as *Thalotia picta*, and Tenison Woods does the same. The species they refer to is *Trochus Lesueuri*, Fischer ; the *Phasianella elegans*, Lamarck. Paetel erroneously attributes *Trochus conicus* to Sowerby.

3. Trochus (Cantharidus) pulcherrimus, *Gray*, sp.

1828. *Trochus pulcherrimus*, Gray ; Wood, Index Test. Suppliment, p. 18, pl. 6, fig. 45 ; *Monodonta pulcherrima*, Gray, l.c., p. 44.

1842. *Trochus Preissii*, Menke, Moll. Nov. Hollandiæ, p. 17, No. 69.

1845. *Trochus pulcherrimus*, Wood ; Philippi Abbild neuer Conch., vol. 2, heft 2 ; Trochus, p. 37, pl. 7, fig. 1.

†*1849. *Trochus pulcherrimus*, Wood ; Philippi in Martini and Chemn, 2nd edition (Kuster), p. 132, No. 153, pl. 23, fig. 4.

1850. *Trochus pulcherrimus*, Wood ; Jay's Catalogue of Shells, 4th edition, p. 306, No. 7,440.

1851. *Thalotia pulcherrima*, Wood; A. Adams, Proc. Zool. Soc., p. 172, No. 2.
1854. *Thalotia pulcherrima*, Wood; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 420.
1856. *Trochus pulcherrimus*, Gray; Wood, Index Test. Suppl., Hanley's edition, p. 221, pl. 6, fig. 45; very bad.
1865. *Thalotia pulcherrima*, Wood; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 179, No. 151.
1873. *Thalotia pulcherrima*, Wood; Paetel, Catalog. der Conch.-Sammlung, pp. 11-73.
1877. *Thalotia mariæ*, Tenison-Woods, Proc. Royal Soc., Victoria, p. 58.
1877. *Thalotia mariæ*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 41.
1881. *Trochus Preissii*, Menke=*Thalotia pulcherrima*, Wood; Tate, P. L. S., N.S.W., vi., p. 396.

Hab.—Swan River, Western Australia (*Preiss*); Cape Riche, King George's Sound, south-west coast of Australia (*J. Brazier*); Hobson's Bay and Port Phillip Heads (*Tenison-Woods*); Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Encounter and Fowler's Bay (*Tate*); Holdfast and Aldinga Bays, South Australia (*G. F. Angas*); North Tasmania (*Tenison-Woods*, *W. F. Pettard*, *Lieut. Beddome*).

This well-known species was re-described by the Rev. Tenison-Woods in 1877 as *Thalotia mariæ*—the type specimen he presented to the Australian Museum.

4. Trochus (Diloma) odontis, *Gray*, sp.

1828. *Trochus odontis*, Gray; Wood, Index Test. Suppliment, pl. 6, fig. 37; *Monodonta odontis*, Gray, l.c., p. 44.
†*1849. *Trochus odontis*, Wood; Philippi, in Conch. Cab., Martini and Chem., 2nd edition, p. 144, pl. 24, fig. 7.
1851. *Chlorostoma odontis*, A. Ad., Proc. Zool. Soc., p. 182, No. 22.
1854. *Diloma odontis*, Wood; H. and A. Adams, Recent Mollusca, vol. 1, p. 420.
1856. *Trochus odontis*, Gray; Wood's Index Test. Suppliment, Hanley's edition, p. 221, pl. 6, fig. 37.
1865. *Diloma odontis*, Wood; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 182, No. 173.
1873. *Gibbula odontis*, Wood; Paetel, Cat. der Conch.-Sammlung, p. 75.
1877. *Trochus* (*Diloma*) *odontis*, Wood; Tenison-Woods, Proc. and Papers, Royal Soc., Tasmania, p. 43.
1880. *Trochus odontis*, Wood; Kiener, Coq. Vivantes Fischer ed. Trochus, pp. 313-423, No. 180, pl. 99, fig. 1.

Hab.—New Holland (*Philippi*); Port Phillip, on the rocks at low water (*Jukes*); St. Vincent's Gulf, South Australia, and Tasmania (*G. F. Angas*); New Holland (*Paetel*); Port Western (*Quoy* and *Gaimard*); Hobson's Bay, Victoria (*R. C. Rossiter*); Port Sorell, Tasmania (*C. E. Beddome*); Wallaroo, South Australia (*G. T. Rossiter*, 1861); St. Vincent's Gulf, South Australia, on rocks at low water (*Prof. Tate*); St. Kilda Beach, Hobson's Bay, Victoria (*J. H. Gatliff*); Hobson's Bay, Victoria (*G. T. Rossiter*, 1862); Brighton, Victoria (*J. F. Bailey*); Blackman's Bay, Tasman's Peninsula, Port Davey, Swansea, and Tamar Heads, Tasmania (*W. F. Pettard*); Cape of Good Hope (*Hanley*, in Wood's Index Test., 2nd edition).

5. Trochus (Diloma) Adelaidæ, *Philippi*, sp.

†*1849. *Trochus Adelaidæ*, Philippi in Martini and Chem., 2nd edition, Kusters, p. 140, No. 168, pl. 24, fig. 1.

1851. *Gibbula Adelaidæ*, A. Adams, Proc. Zool. Soc., p. 186, No. 22.

1854. *Oxystele Adelaidæ*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 427.

1873. *Oxystele Adelaidæ*, Phil.; Paetel, Cat. der Conch.-Sammlung, p. 74.

1876. *Diloma Australis*. Tenison-Woods. Papers and Proc. Royal Society of Tasmania, p. 145.

1877. *Trochus* (*Diloma*) *australis*, Tenison-Woods, Papers and Proc. Royal Society of Tasmania.

1880. *Trochus Adelaidæ*, Phil.; Kiener, Coq. Vive, Fischer ed. Trochus, p. 210.

1884. *Diloma australis*, Tenison-Woods; Hutton, Proc. Linn. Society of N.S.W., vol. 9, p, 368.

Hab.—Rossiter Bay, Recherche Archipelago, Great Australian Bight (*Captain Thomas Rossiter*, 1841); Rocks at low tide, Great Australian Bight (*Professor Tate*); St. Vincent's Gulf, South Australia (*W. T. Bednall*); Adelaide in New Holland (*Philippi*); North coast of Tasmania (*W. F. Pettard*); Cape Riche, King George's Sound (*Brazier*); Portland, Victoria (*J. H. Gatliff*).

I have the original specimens of this species, and many others collected by my father-in-law, Captain Thomas Rossiter, in 1841. The year that he saved Mr. John Eyre (now Sir John Eyre) from starvation when on his ever-memorable trip overland from Adelaide to King George's Sound. Specimens I distributed some years ago as *Trochus Adelaidæ*, Philippi, they being identified by the late Messrs. Henry and Arthur Adams, but for some unknown reason the Rev. Tenison-Woods re-describes it as *Trochus australis*. I have seen it in collections named *Trochus odontis*, Gray, var. specimens from St. Vincent's Gulf sent by Mr.

Bednall some years back as *Trochus odontis?* Wood. I think that Mr. Angas must have mixed up two species in one. He only mentions *Trochus odontis* in his list of the South Australian Mollusca.

6. Trochus (Zizyphinus) Meyeri, *Philippi*, sp.

1848. *Trochus Meyeri*, Philippi, Zeitscher fur Malak, p. 101.
†*1849. *Trochus Meyeri*, Philippi, in Conch. Cab., 2nd edition, p. 279, No. 362, pl. 41, fig. 4.
* *Trochus armillatus*, Kiener, Coq. Viv. Genus Trochus, p. 17, fig. 2 (non *Trochus armillatus*, Wood, Index Test).
1854. *Trochus levis*, Hombron et Jacquinot Voyage au Pôle Sud, vol. 5, Zoologie, p. 56, atlas plates, Mollusca, pl. 14, fig. 17-18.
1863. *Zizyphinus armillatus*, Reeve, Conch. Icon., p. 3, fig. 19 (non *Trochus armillatus*, Wood).
1865. *Zizyphinus armillatus*, Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., p. 180 (non *Trochus armillatus*, Wood).
1873. *Zizyphinus armillatus*, Paetel, Catalog. der Conch.-Sammlung, p. 73 (non *Trochus armillatus*, Wood).
1873. *Zizyphinus Meyeri* (Dunker!!), Paetel, Catalog. der Conch.-Sammlung, p. 74.
1877. *Zizyphinus armillatus*, Tenison-Woods, Papers and Pro. Royal Society of Tasmania, p. 41 (non *Trochus armillatus*, Wood).
1880. *Trochus Meyeri*, Philippi; Fischer, in Kiener Coq. Vivantes Genus Trochus, p. 76, No. 10.

Hab.—King's Island, Bass Straits (*Peron* and *Lesueur*, Naturalists to Captain Baudin's Expedition); Encounter and Guichen Bays, South Australia (*G. F. Angas*); New Holland (*Hombron* and *Jacquinot*); Tasmania (*Paetel*, *Beddome*, *Woods*, *Pettard*); Australian Sea (*Paetel*); Western Port, inside the West Head (*J. H. Gatliff*); Coast of Australia (*J. Verreaux*).

It is quite a mystery how this species has got confused with the *Trochus armillatus* Wood figured in the Suppliment to the Index Testaceologicus, in 1828, The *Trochus Meyeri*, Philippi, is quite distinct both as regards colour and sculpture; the figure given by Reeve as *T. armillatus* is very bad. The figures given by Philippi, Kiener, and Hombron and Jacquinot of this well-known species are not to be surpassed. Paetel erroneously attributes this species to Dr. Dunker.

7. Trochus (Clanculus) Dunkeri, *Koch*, sp.

1843. *Trochus* (*Monodonta*) *Dunkeri*, Koch in Philippi, Abbild und Besch neuer oder Conch., vol. 1; Trochus, heft. III., p. 67, pl. 2, fig. 5.

†1849. *Trochus Dunkeri*, Koch; Philippi in Conch. Cab., 2nd edition, p. 237, No. 300, pl. 36, fig. 5.
1851. *Monodonta Dunkeri*, Koch; A. Adams, Proc. Zool. Soc., p. 174.
1854. *Euchelus Dunkeri*, H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 419.
1865. *Clanculus rubens*, A. Adams; Angas, Molluscan Fauna of the Province of South Australia, Proc. Zool. Soc., p. 178.
1877. *Clanculus rubens*, A. Adams; Tenison-Woods, Papers and Proc. Royal Society of Tasmania, p. 40.
1880. *Trochus* (*Clanculus*) *Dunkeri*, Koch; Kiener, Coq. Vivantes Fischer ed., p. 301 and 422, No. 171, pl. 96, fig. 2.

Hab.—? (*Koch*); Adelaide in New Holland (*Philippi*); St. Vincent's Gulf (*G. F. Angas*, *Tate*); Bass' Straits (*Tenison Woods*); Streaky Bay (*Tate*).

8. Diala lauta, *A. Adams*, sp.

1862. *Diala lauta*, A. Adams, Ann. Nat. Hist., vol. 10, 3rd series, p. 298, No. 5.
1865. *Diala lauta*, A. Adams; Angas, Proc. Zool. Society, p. 173, No. 111.
1873. *Diala lauta*, A. Adams; Paetel, Catalog der Conch.-Sammlung, pp. 6-49.
1875. *Diala Punctata*, Tenison-Woods, Paper and Proc. Royal Soc., Tasmania, p. 147.
1875. *Diala lauta*, A. Adams; E. A. Smith, Proc. Zool. Soc., p. 538.
1877. *Diala punctata*, Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 37.

Hab.—Port Adelaide (*A. Adams*); St. Vincent's Gulf, in shell sand at the head of Spencer's Gulf, South Australia (*G. F. Angas*); D'Entrecasteaux Channel, South Tasmania (*Rev. H. D. Atkinson*); very abundant on the Zostera fields in sheltered stations throughout South Australia (*Tate*).

9. Diala monile, *A. Adams*, sp.

1862. *Alaba monile*, A. Adams, Ann. Nat. History, vol. 10, 3rd series, p. 296, No. 17.
1865. *Alaba monile*, A. Adams; Angas, Proc. Zool. Soc., p. 173, No. 109.
1875. *Diala tesselata*, Tenison-Woods, Papers and Proc. Royal Society, Tasmania, p. 147.
1875. *Diala monile*, A. Ad., E. A. Smith, Proc. Zool. Soc., p. 538.
1877. *Diala tesseluta*, Tenison-Woods, Papers and Proc. Roy. Soc., Tasmania, p. 37.

Hab.—Port Lincoln (*W. Metcalfe, A. Adams*); Port Lincoln, South Australia, in shell sand (*G. F. Angas*); Crookhaven Head, New South Wales, in shell sand found on the beach (*J. Brazier*).

10. Cassis semigranosa, *Lam.*, sp.

1822. *Cassis semigranosa*, Lam., Hist. Anim. sans Vert., tome 7, p. 228, No. 23.
1824. *Cassis semigranosa*, Lam., Dubois' Epitome of Lamarck's Arrangement of Testacea, p. 253.
1828. *Buccinum semigranosum*, Wood, Index Test. Suppliment, p. 11., pl. iv., fig. 2.
**Cassis semigranosa*, Lam.; Kiener ed. Fischer, Icon. Coq. Viv., p. 36, No. 23, pl. 14, fig. 29.
1844. *Cassis semigranosa*, Lam., Anim. sans. Vert. (Deshayes ed.), vol. 10, p. 37.
1845. *Cassis semigranosa*, Lam.; Catlow and Reeve, Conchologists' Nomenclator, p. 263, No. 37.
1848. *Cassis semigranosa*, Lam.; Reeve, Conch. Icon., vol. v., p. 1, species 3.
1850. *Cassis semigranosum*, Lam.; Jay, Catalogue of Shells, 4th edition, p. 345, No. 8,736.
1853. *Semicassis semigranosa*, Lam.; H. and A. Adams, Genera of Recent Mollusca, vol. 1, p. 216.
1856. *Buccinum* (*Cassis*) *semigranosa*, Lam.; Hanley, in Index Test. Suppliment, 2nd edition, p. 212, pl. 4, fig. 2.
1857. *Csssis semigranosum*, Wood; Küster, in Martini and Chem., 2nd ed., p. 24, pl. 44, fig. 6, 7.
1859. *Cassis* (*Semicassis*) *semigranosus*, Lam.; Chenu, Manual de Conch., tome 1, p. 206, fig. 1,124.
1860. *Cassis semigranosa*, Lam.; W. Theobald, Catologue of the Recent Shells in the Museum Asiatic Society of Bengal, p. 18, No. 10.
1865. *Semicassis semigranosa*, Lam.; Angas, Molluscan Fauna of South Australia, Proc. Zool. Soc., London, p. 168.
1873. *Cassis* (*Phalium*) *semigranosa*, Lam.; Paetel, Cat. der Conch.-Sammlung, p. 5-44.
1876. *Cassis semigranosa*, Lam.; Tenison-Woods, Proc. and Papers of the Royal Society of Tasmania, p. 33.
1885. *Cassis* (*Semicassis*) *semigranosa*, Wood; Tryon, in Manual of Conchology, vol. 8, p. 275, pl. 3, fig. 60.

Hab.—Seas of New Holland (*Lamarck*); Van Diemen's Land (*Reeve*); Seas of New Holland (*Kiener*); Coast of New Holland (*Küster*); Van Diemen's Land (*Hanley*); Aldinga Bay, Encounter Bay, South Australia (*G. F. Angas*); Wallaroo Bay (*Tate*); Tasmania (*Beddome, Petterd, Simson, Woods*).

This well-known species was first described by Lamarck in 1822, mentioned again in 1824 by Dubois, in his Epitome of

Lamarck's Arrangement of the Testacea, in 1824. Wood, in his Index Test. Suppliment, 1828, figures it as *Buccinum semigranosum* from specimens in the British Museum. Kiener, in his Coquilles Vivantes, figures it as *Cassis semigranosa*, Lam. Deshayes, Catlow and Reeve, Jay, H. and A. Adams, Hanley, Chenu, Theobald, Angas, Paetel, Tenison-Woods, all quote Lamarck; and after 62 years we are told that Wood is the authority for the species by Mr. Tryon, in his Manual of Conchology, vol. 8, p. 275, 1885, and quotes Reeve, Conch. Icon., for it. Reeve does not quote Wood, but Lamarck, Anim. sans Vert. (Deshayes' edit.), vol. X., p. 37. Küster, in Conchilien-Cabinet, Martini and Chemnitz, 2nd edition, 1857, quotes Wood, and ignores Lamarck. Of all the authorities I have quoted from 1822 until 1885, Küster and Tryon are the only two who have given Wood as the authority—probably an oversight; but it causes endless confusion to young students who have not a large library to consult. I am very often asked who is the authority for the species, Lamarck or Wood. My list drawn up in this paper will show all students the authority for the species.

11. Cerithium (Potamides) monachus, *Crosse* and *Fischer*, *sp.*

1855. *Cerithium dubium*, Sowerby, Thes. Conch, vol. 2, p. 864, No. 2, pl. 181, fig. 120 (non *Cerithium dubium*, Sowerby, Mineral Conch., 1816).

1864. *Cerithium monachus*, Crosse and Fischer, Journal de Conch., p. 347, pl. 3, fig. 17-18.

1865. *Potamides monachus*, Angas, Molluscan Fauna of South Australia, Pro. Zool. Soc., p. 171, No. 97.

1865. *Cerithium dubium*, Sowerby; Reeve, Conch. Icon., pl. 12, species 78 *a–b* (non Sowerby, 1816).

1877. *Cerithium dubium*, (Reeve!!); Tenison-Woods, Papers and Proc. Royal Society, Tasmania, p. 35 (non *dubium*, Sowerby, 1816).

1880. *Cerithium eludens*, Bayle, Journal de Conch., vol. 27, 3rd series, p. 245, No. 9.

Hab.—Van Diemen's Land (*Sowerby*); Yorke's Peninsula, Adelaide Creek, South Australia (*G. F. Angas*); on the beach at St. Kilda, Melbourne (*G. F. Angas*); occasionally taken alive in shallow water in St. Vincent Gulf, and beach specimens have been gathered at several stations in Spencer Gulf (*Tate*).

Sowerby described in his Mineral Conchology, in 1816, a *Cerithium dubium*. Bayle, in the French Journal, 1880, renames it as *Cerithium eludens*, not knowing that Crosse and Fischer had described it as *Cerithium monachus* in the same Journal for 1864. Crosse and Fischer's name must stand good.

12. Turbo Gruneri, *Philippi.*

1846. *Turbo Gruneri*, Philippi in Zeitschrift fur. Malak, p. 98; Philippi in Martini and Chemnitz Conch. Cab., 2nd edition, p. 52, pl. 12, fig. 7.
1848. *Turbo circularis*, Reeve, Conch. Icon, pl. 10, sp. 46.
1854. *Senectus circularis*, Reeve; H. and A. Adams, Recent Mollusca, vol. 1, p. 392.
1865. *Senectus circularis*, Reeve; Angas, Marine Molluscan Fauna of the Province of South Australia, Proc. Zool. Soc., p. 177.
1873. *Turbo circularis*, Reeve; Fischer in Kiener Coq. Vivantes, p. 99, pl. 42, fig. 1.
1873. *Turbo* (*Senectus*) *circularis*, Reeve; Paetel Catalog der Conch.-Sammlung, p. 71.
1877 *Turbo* (*senectus*) *circularis*, Reeve; Tenison-Woods, Papers and Proc. Royal Soc., Tasmania, p. 38.
1885. *Turbo curcularis*, Reeve; Sowerby, Thes. Conch., p. 203, sp. 42, pl. 4; Thes., plate 496, fig. 37.

Hab.—Adelaide, South Australia (*Philippi*); "——?" (*Reeve*); St. Vincent's Gulf, South Australia (*G. F. Angas*); Holdfast Bay (*W. T. Bednall, Tate*); King's Island, Bass Straits (*Tenison-Woods*); Swan River, Australia (*Sowerby*).

I hope soon to give Part II. with a number of species that have not been recorded by Mr. G. F. Angas since they were described in 1843. Specimens that I have were collected at Port Lincoln. I have to thank Professor Tate, Messrs. Bednall, Beddome, Pettard, Gatliff, and other friends for numerous species with correct localities.

A Classified List of Geometrina found round Balhannah, with Notes on Species.

By E. Guest, Balhannah.

[Read October 5, 1886.]

The Geometrina of South Australia, so far as I know, are included in five sub-families—the *Larentidæ*, *Ænochromidæ*, *Geometridæ*, *Acidalidæ*, and *Boarmidæ*.

The genera, with the exception of perhaps half a dozen, appear to be distinct from those of Europe, and I do not think that a single species mentioned below is common to these two parts of the world. The larvæ feed on trees and shrubs, as a rule, although I have little doubt that some of those of the *Acidaliadæ* are found on grass or low herbs. They are generally solitary, devoid of hair, and have the prolegs or claspers on the posterior segments only, which causes the larva to loop or draw up its body in walking. Many of the Australian species attach themselves by the anal pair to some twig or leaf, and stretch the body straight out, in which position they look exactly like a small dead branch. The perfect insects may be found flying over grass, beaten from trees or shrubs, or sitting with expanded wings on fences or walls. They mostly fly in the evening, but some few appear to be day-flying as well. I have no intention of minutely describing the species, as this has already been done by abler pens than mine, but shall draw attention to such prominent markings as may enable the student to recognise such examples as may be included in this list.

The mean will be generally given in inches and lines (thus ′ and ″), but where the sexes vary very much in size, that of both will be mentioned if known.

SUB-FAMILY I.—LARENTIDÆ.

Is represented in my collection by nineteen species and seven genera. They are small or medium-sized insects, frequenting grassy places, and may often be found on fences; but I do not think that they are as a rule much attracted by light.

1. Microdes villosata, *Gn.*

Expanse, 10″. Out in November.

Fore-wings dark ash-gray, mottled with darker. Hind-wings yellowish white, with a round nearly black spot at lower edge,

near anal angle. This looks as if it had been burned through the wing, and distinguishes the species immediately. Generally considered common, but I have only once captured it in this locality.

2. Phrixogonus laticostatus, *Walk.*

Expanse, 7″. October, November, December, and again in March.

General colour purplish-brown, with a much darker irregular bar across the wing. The male may be known at once by a long tuft of scales projecting from costa at one-fourth from base. This is absent in the female, which has also the dark bar much narrower and quite straight. A common insect; sits on tree trunks and fences.

3. Phrixogonus insigillatus, *Walk.*

Expanse, 6″ to 7″. March.

Fore-wings more pointed and costa more arched than in *laticostatus*, and it is also lighter coloured. The costal tuft is wanting, but there is a raised knob of scales below costa at one-half. Not common.

4. Epicyme rubropunctaria, *Dbld.*

Expanse, 10″. November and December, and again in March.

A pretty light pink-coloured insect, with fine transverse lines of a darker shade. There are generally three or four large confluent purplish-red spots running from centre of wing to inner margin, but these are often nearly obsolete, and in one of my specimens they form a band running right across the wing. Common.

5. Anachloris subochraria, *Dbld.*

Expanse, 1′. October to May.

Bright orange yellow, with a tawny stripe across wing at two-thirds. Hind margin tawny, and the space between this and central stripe is often suffused with a lighter shade of the same colour. Very common.

6. Cephalissa severata, *Gn.*

Expanse, 1′ October and November.

Dark grey, with nearly black basal patch, and a broad black stripe across centre of wing. The female is more obscurely marked than the male, and might almost be taken for another species. Sits on prostrate logs, and flies very fast when disturbed. A common species.

7. Cephalissa Mortuata, *Gn.*

Expanse, 11″. March and April.

A very variable insect, if indeed all my varieties really belong to this species, as is Mr. Meyrick's opinion at present. They may mostly, however, be known by a transverse bar, broad on costa, narrow on inner margin, very angulated on outside and margined by *a white line, which expands into a kind of spot near the costa*. The ground colour is dark greyish-brown, and the females are darker than the males. Common.

8. Cephalissa chimarrhoa, *Meyr.*

Expanse, 10″.

All the wings a bright lustrous yellowish-brown, difficult to describe. Across the wing, rather beyond one-half, is a series of seven or eight small triangular spots, with the apices turned inwards and black, the bases being white. This little insect was unknown until I took it, and I believe it has as yet only occurred here.

9. Cephalissa microcyma, *Meyr.*

Expanse, 11″.

At first sight this looks something like *chimarrhoa*, but the ground colour is lighter, the triangular spots are wanting, and the antennæ of male are plumated, whilst in that insect they are almost simple. Fairly common some years, flying among grass, but appears to be confined to South Australia, and was unknown until I took it.

10. Cephalissa holophanes, *Meyr.*

Expanse, 1′ 1″. October and November.

Fore-wings yellowish grey, with a very faint and indistinct darker bar, *which is nearly straight-edged*, across the centre. In some specimens, however, this is almost obsolete. Hind wings bright yellow, with darker hind margins. Only found in South Australia, and is in few cabinets as yet. It is pretty common around Balhannah, and was first taken by myself.

11. Cephalissa lamprotis, *Meyr.*

Expanse, 10″. March.

Fore-wings purplish-grey, with a broad dark purplish-brown bar across centre, very sharply angulated outwards; beyond this, on the costa, are two patches of the same colour, the first larger than the second. The hind wings are deep orange, suffused with brown. This small but handsome insect appears to be really scarce everywhere, although widely distributed. Found among grass on hillsides.

12. Cephalissa languescens, *Rosenstock.*

Expanse, 1′ 1″. Fore-wings dark-brown, with a still darker bar across the centre. Hind-wings dark orange, suffused with

brown towards anal angle. Not a common insect, and, I believe, restricted to this colony. Flies in March.

13. Cephalissa vacuaria, *Gn.*

Expanse, 1′ 1″. March and April.

A variable insect as to ground colour, which is sometimes dark-brown, sometimes tawny. There is always, however, a nearly black bar, broad at costa and pinched in the centre, running across the wing, and very much angulated on the outside. The hind-wings are grey. A common insect, flying over grass.

14. Cephalissa strumosata, *Gn.*

Expanse, 1′ 5″. December and January.

This is the largest and darkest of the genus yet found by me. The ground colour, however, varies a good deal, being sometimes very dark grey, and sometimes, especially in the females, positively black, in which case the head, thorax, and body are all of the same sombre hue. There is always a darker broad bar crossing the wing, very much angulated on the outside, and distinguished from any other species known to me by having two protuberances close together. Sits on palings and trees—the dark ones on charred trunks, where, in spite of their size, they are almost invisible. Rather a common species.

15. Cephalissa subrectaria, *Gn.*

Expanse, 10″ to 1′ 1″. September and October.

A dull-coloured insect frequenting damp places near creeks, rivers, &c. It may be known at once by a straight, narrow, silvery-white bar crossing the fore wings at three-fourths, and another broader, but less distinct rounded one, at one-fourth from base. Generally common.

16. Cephalissa uncinata, *Gn.*

Expanse, 10″ to 1′ 1″. October and November.

A very variable insect, both in markings and ground colour, but nevertheless easily distinguishable. The ground colour varies from yellowish-brown to purplish-red. There is always a band crossing the wing, broad on costa, narrow on inner margin, rounded on the interior, angulated on the exterior, and a dark wedge-shaped spot at costal apex, which latter is more hooked than in any other species of this genus. The extreme outer edge of outer margin is distinctly white. A very common insect in the hills. Flies over and among grass.

17. Epyaxa subidaria, *Gn.*

Expanse, 1′ 1″. September and October.

This is also rather a variable insect, at first sight something like *C. vacuaria*. The antennæ of male are, however, plumate

in *subidaria*, and simple in the other. The cross-bar also in the present species is bordered outside with white, which is not the case in *vacuaria*. A common insect in the spring.

18. Larentia vicissata, *Gn.*

Expanse, 1′ 3″. March and April.

A bright-coloured insect, easily distinguished by its orange under-wings and a broad straight silvery bar crossing the fore-wings at three-fourths. The antennæ of male are plumate, those of the female simple, and with this exception the two sexes are alike. A common insect in woods.

19. Larentia heliacaria, *Gn.*

Expanse, 1′ 1″. April and May.

May be known by four narrow silvery lines crossing fore-wing at regular intervals; the first is round, second slightly angulated, third is sharply zigzaged, and the outer one rounded. The hind-wings are dull reddish-yellow. Common in paddocks.

SUB-FAMILY II.—ÆNOCHROMIDÆ.

Of this sub-family I possess at present 11 species in eight genera, but I have little doubt that there are many more. It contains some of the largest and finest of our Geometrina, but unfortunately these all appear to be rare, and, judging from my own experience, it may be years before the collector meets with them. The fore-wings are more or less hooked at tip, and the antennæ of the males are generally plumate.

1. Lamacha flavicapitata, *Gn.*

Expanse, 1′ 3″. September and October.

Ground colour of male grayish-ash colour with a yellow rounded stripe, bordered *inside* with bright red ;brown across the wings at about one-fourth, another also yellow bordered *outside* with brown at about two-thirds. The yellow head is conspicuous in both sexes. In the female the space between the two lines is filled up with dark brown, which extends outwards some little way past the second line, and gives this sex a very distinct appearance. It is rather smaller than the male, which is unusual, the reverse being generally the case. The male has a distinct black centre spot. Rather a common insect.

2. Taxeotis intextata, *Gn.*

Expanse, 1′. Out all the summer.

An obscurely marked silvery-gray moth. The most prominent markings are, first a row of small round black dots crossing wing at one-fourth, and second a similar row running from costa to anal angle. A common insect.

3. Taxeotis arenifera̲ta, *Gn.*

Expanse, 1′ 1″. November and December.

A very variable moth, hardly any two being exactly alike. The males are light, and the females dark-brown, and the most constant mark is a line running diagonally across both wings from near costal apex of fore-wing to near the centre of hind margin of hind-wing, although I have specimens in which even this is reduced to a series of dots. The space outside this is generally darker than the rest of the wing, and in some specimens there is also a straight line crossing fore-wing only, at one-fourth from base. A common insect among grass.

4. Nearcha buffalaria. *Gn.*

Expanse, 1′ 5″. October, January, and February.

An obscurely-marked, although, when fresh, a pretty insect. It flies very fast, and its wings being very thin and delicate, it is difficult to get a good specimen. The ground colour varies from dark-brown to pale-yellowish, but there is always in the male a darker undulating line running from below costa (not from it), at two-thirds, to inner margin. Just inside this are about eight black dots irregularly distributed. These are wanting in the female, in which sex also the line is suffused and more orange-coloured. Not uncommon sitting on the ground among dead leaves.

5. Dichromodes ainaria, *Gn.*

Expanse, 1′ 1″. September and October, and again in the autumn.

The fore-wings of this little moth are difficult to describe, but the insect may be known at once by the bright orange under-wings, with deep black border, differing in this respect from any other Geometer I have seen out here. The fore-wings are blackish-brown, with still darker lines and markings. A common scrub insect, but not found in grass paddocks.

6. Dichromodes obtusata, *Gn.*

Expanse, 1′ 11″. December.

An obscure slaty-gray moth, with all four wings alike. A darker-coloured bar crosses the fore-wing of the male, but the female is almost unicolorous. Pretty common, but from its sluggish habits and dull colour not often noticed.

7. Dichromodes stilbiata, *Gn.*

Expanse, 1″ 11″. November, and perhaps December.

I have never yet succeeded in finding this moth in good condition, but the most distinguishing marks appear to be three oblique silvery bars crossing the wing—one near base, the second at three-fourths, and the third along outer margin.

The two first slope inwards, the third one outwards. A rare insect in this part.

8. Ænochromia vinaria, *Gn.*

Expanse, two inches. December and January.

When fresh, the thorax, body, and all the wings are of a beautiful purple-red or plum colour, but this soon fades to a yellowish-red. A broad yellow stripe runs from costal apex, which is much hooked, across both wings in a diagonal direction to centre of inner margin of hind wing. There is a black centre-spot, with yellow eye, and an indistinct line near base. The body is very thick and flat, and perhaps a beginner would hardly take it to be a Geometer at all.

Larva, length, 1′ 10″. Prolegs, 6, on 9-10-13 segs.

On the top of back on the eleventh segment are two large raised yellow spots with black circles. On the fourth segment are two hard black pointed horn-like projections with pale yellow bases, and on the sixth segment are two more, but here the horns are barely visible. The spiracles are small, but distinct, and orange coloured. The body is smooth, ground colour brownish-green, darkest above. Belly nearly white. The back is covered with minute white spots, from some of which a short black hair issues, but it requires a lens to see these. Head long and attenuated, reddish-brown in colour. Reposes with the body thrown out perfectly straight from the twig. Is said to feed on Hakea, but I have only found it as yet on Banksia marginata. Not common here.

9. Arhodia lasiocamparia *? Gn.*

Expanse, male, 2′ 2″; female, 3 inches, but varies a good deal in size. November and December.

Colour of all the wings bright yellowish-gray, minutely speckled with darker. A small and sometimes not very distinct centre spot on each wing. Sometimes, especially in the females, the whole of the wings are suffused with pink. This moth may be easily known by a large dark purple blotch on the underside of fore-wing near costal apex. The body is very stout and thick. Antennæ are shortly pectinated in the male, simple in the female. Rather a scarce insect, and there is some doubt as to the name. My insects do not appear to tally exactly with Guenée description, and they may perhaps be an allied species.

Larva, about two inches long, colour greenish-red; quite smooth; spiracles not very distinct. Prolegs on ten and thirteen segments, the latter very broad and flat. A rudimentary pair on ninth segment, but these are not used in walking. Sits stretched straight out from the twig, but when touched it

curls the forepart round with the head underneath, like a pastoral crook. On the back of the twelfth segment is a projecting semicircular disk, yellow above, black beneath. Loops very much in walking. It is full fed about the end of February, and passes the winter in the pupa state. Food plant, white gum.

10. Phallaria ophiusaria, *Gn.*

Expanse, 2′ 6″, 2′ 11″. March 3rd, 1886.

Wings ample, fore-wings strongly hooked at tip; all the wings pale greenish-brown, with a very distinct ferruginous coloured stripe running from costa, near apex, in a curved direction, across both to centre of inner margin of hind-wings. The inside of this is faintly bordered with yellow. There is also a large white spot with dark border in centre of each wing. Antennæ strongly pectinated in male, thickened only in female. Rare up here—in fact, I have as yet only taken one female. The larva is unknown to me, but is said to feed on Callistemon. I knocked my specimen out of a white gum sapling; it flew slowly and heavily.

11. Gastrophora henricaria, *Gn.*

Expanse (male) 2′ 7″. October 29, 1884.

Fore-wings ample costa slightly rounded; apex acute; hind margin straight, oblique. A dark purple bar crosses the fore-wing in the centre from costa to inner margin. The basal half of wing is light yellowish-gray, the posterior half much darker purplish-gray. Thorax and body white. Hind-wings bright orange with a broad deep purple transverse bar, outside of which are eight round purple spots. Antennæ of male very highly plumose and white. I do not know the female nor anything about the larva. My specimen came to light. Mr. Meyrick says that this beautiful insect used to be not uncommon in old collections, but he had never seen a recent specimen except mine.

SUB-FAMILY III.—GEOMETRIDÆ.

Up to the present time I have only obtained two genera with five species of this sub-family, but I know that there are several others. They are mostly green or greenish-gray insects, and appear to be generally distributed, and I doubt if any be really rare.

1. Iodis externa, *Walk.*

Expanse, 1 inch. November, December.

All the wings bright green, with a small dark spot in centre of each. Collar, costa and cilia crimson. Not very common here; generally considered a scarce insect.

2. Iodis vertumaria, *Gn.*

Expanse, 1′ 6″.

This is the largest of the genus known to me. All wings bright green, no centre spot. Collar green, costa and cilia light yellow. A common insect.

3. Iodis dichloraria, *Gn.*

Expanse, 1′ 2″.

All the wings bright green, no centre spot. Collar bright orange, costa and cilia straw-coloured. A very common moth.

4. Iodis carenaria, *Gn.*

Expanse, 11″. March, April.

All the wings bright apple-green. There is a small and rather indistinct purple spot on fore-wing rather below the costa, and a large square red one in centre of hind-wing. Collar, costa, and cilia red. This is the smallest, and in this neighbourhood the rarest of the genus. When fresh it is a very pretty insect.

5. Hypochroma occultaria, *Don.*

Expanse, male, 1′ 7″; female, 1′ 10″. March and April.

A variable insect as to size. I have males only 1′ 2″ across the wings. The upper side of all the wings is a bright silvery-gray, with transverse wavy lines, and a black dash running from the centre of the costa of fore-wing to middle. Underneath the wings are all snow white, with two egg-shaped black spots near base, a larger one beneath centre of costa; a crimson line running from costa half-way across wing, beyond which is a large black smear. The underneath of hind-wings show a deep black border lined with crimson inside. There is also a sharp-edged, triangular, cinnamon-coloured spot that appears to be devoid of scales about the centre of fore-wing, the apex pointing inwards. The antennæ of male are plumose, but running to a point. Those of the female are simple.

Larva.—Length, 2′ 2″. Prolegs appear to exist only on the twelfth and thirteenth segments, but the segments are very crowded together, and the front pair may be on the eleventh. The thirteenth segment is a bifid arrangement running to a point behind, and cleft. No sign of any other prolegs, the belly, even under a lens, appearing smooth and polished. The legs proper are also very small, and nearly invisible when the larva is at rest. The head terminates in a long pointed projection similar to that at the anal end, only it is hard, and not cleft. Colour, all over alike; dull apple-green, with a dull crimson stripe down each side, in which are the spiracles, which are small and black, and up the centre of the belly runs a narrow yellowish-white stripe. Feeds on white gum; holds

very hard to the leaf, with the body thrown out straight and rigid. Of course loops very much in walking. Full-fed about the middle of December.

SUB-FAMILY IV.—ACIDALIADÆ.

This sub-family is represented here by only four species, but three at least of these by their great numbers are perfect pests to the collector.

1. Acidalia recessata, *Walk.*

Expanse, 10″. Out all summer and autumn.

All the wings light-grey, with various faint wavy lines. Sits with its wings expanded on leaves, &c. Extremely abundant.

2. Acidalia albicostata, *Walk.*

Expanse, 7″. All the spring and summer.

A small, and when fresh, pretty insect; but it soon fades. All the wings light purplish-red, with a broad light bar beneath costa of fore-wings. I generally beat it from Banksia, but hardly think that is its proper food-plant, or, at any rate, not the only one. The male is much smaller and brighter than the female. Very abundant.

3. Acidalia prosaula, *Meyr.*

Expanse, 8″.

The two sexes are very different looking in this species. The male is generally nearly unicolorous, of a dark olive-brown colour. The female is much lighter and grayer, with a broad transverse band crossing both wings.

A local and rather scarce little insect, that had been overlooked until I took it, and has been as yet only found in this immediate neighbourhood. Flies over and among grass.

4. Acidalia rubraria, *Dbld.*

Expanse, 10″. Flies all the year round, except perhaps in July.

This is the little reddish brown moth that anybody walking through the hill paddocks or scrub kicks up by hundreds. The ground colour is variable, but the markings consist principally of two wavy dark lines across both wings, inside which the colour is lighter. This appears to be constant, whilst other lines vary in almost every specimen.

SUB-FAMILY V.—BOARMIADÆ.

This sub-family appears to be the best represented of any in this neighbourhood, and contains many striking forms. Up to the present I have taken 24 species in fourteen genera. As a rule they are medium or large-sized moths, the greater number

occurring in the autumn. Many of the species are very similar to one another, and hard to separate in the perfect state, especially the females.

1. Scioglyptis canescaria, *Gn.*

Expanse, 1′ 3″. Flies in autumn.

A sombre, dark brown insect, mottled with darker shadings. A broad suffused black band crosses both wings from costal apex of fore to centre of inner margin of hind-wing. Beneath this is a narrow wavy white line. A common Queensland insect, but rare here.

2. Scioglyptis mundifera, *Walk.*

Expanse, 1′ 3″. Generally found in autumn, but there is sometimes a spring brood also. Variable.

Somewhat similar to the last, but the ground colour is much paler; the markings and transverse bar have a distinct purplish tinge, and the white line is altogether absent. Most likely not uncommon, but I have as yet secured few specimens, having long confused it with the following species.

3. Thallogama attenta, *Walk.*

Expanse, 11″. April and May, and perhaps in the spring.

In outward appearance very like the last, but besides its smaller size, the antennæ of male, although pectinated, have the pectinations much shorter than in *Scioglyptis*, in which they are very long.

4. Zermizinga indocilisaria, *Walk.*

Expanse, 1′ 3″. April.

Ground colour brown, with various wavy black lines crossing both wings. It may be distinguished from any of the preceding by these lines starting from the costa, and not the apex of the wing, and by the long light-coloured ciliations of the antennæ of the male. The female is semi-apterous. Apparently scarce here, but widely distributed in Australia, and is also found in New Zealand.

5. Phelotis cognata, *Walk.*

Expanse, 1′. August, also February and March.

Ground colour silvery-gray, with various indistinct black dots and lines crossing the wing from costa to inner margin. The ciliations of the antennæ are very long for about three-quarters of its length, then shorten off rapidly, and the end is simple.

6. Phelotis excursaria, *Gn.*

Expanse, 1′ 6″.

I am rather uncertain about this species, and may have two

allied forms mixed together, but the true *P. excursaria* may, I think, be known by the strongly indented outer margin of hind-wings. It is a difficult insect to describe, and the description would read much like some of the preceding, but it is distinct enough to the eye, the ground colour being a kind of bright tawny-brown, and there is one narrow black line running from three-fourths of costa in a zigzag direction to centre of wing, and then turning abruptly is continued towards inner margin. I do not notice this on any of the other species. Rare here, and I am uncertain about date of capture.

7. Neritodes verrucata, *Gn.*

Expanse, 1′ 3″. October, November.

All the wings pale gray, but when quite fresh suffused with a delicate green tinge. The male has a curious round raised spot near base of fore-wing, which, however, is absent in the female. A common insect among grass.

8. Amelora leucaniata, *Gn.*

Expanse, 1′ 6″. March.

Ground colour pale greenish-brown with nine latitudinal black bars, between each of which are silvery-white ones, also nine in number. The head is yellow and hind-wings light-brown or pale smoke colour. This handsome moth is common most seasons amongst grass, and flies fast.

9. Amelora goniota, *Meyr.*

Expanse, 1′. March.

Wings silvery gray with a greenish tinge. A very distinct, but narrow black angulated line, crosses the fore-wing at about one-fourth, and another very zigzag one at about three-fourths. There is also a large but indistinct central blotch. A scarce moth, of which I have only as yet taken two or three specimens, and I do not think that it is known elsewhere.

10. Amelora demistis, *Meyr.*

Expanse, 1′ 3″. Autumn months.

This is another species that has as yet only been taken here, and I am still uncertain about the exact date, having confounded it with the following species. It is a dull brownish-gray moth, centre spot indistinct, and the transverse lines reduced to rows of dots. It is certainly the most unattractive looking of the genus.

11. Amelora sparsularia, *Gn.*

Expanse, 1′ 11″. March.

Something like *A. demistis*, but smaller and brighter coloured. The black dots forming the lines are closer together, smaller,

and blacker, and there is generally a very distinct centre spot. A common insect, flying among grass.

12. Amelora amblopa, *Meyr.*

Expanse, 1′ 5″. March.

Ground colour much as in *A. demistis*, but there is a dark rounded line running from costa at four-fifths to inner margin at two-thirds. Outside this the colour is more of a silvery gray. A common moth, but appears to be rather local.

13. Epicompsa xanthocrossa, *Meyr.*

Expanse, 8″. March 26th, 1886.

This pretty little insect is in shape a good deal like the English Peacock Moth (*Macaria notata*), to which it is in fact related. My one specimen is the only one known, and it was taken just about daybreak. The general tint of fore-wings is ash colour, but the extreme costal edge is orange, and a narrow stripe of the same colour runs round the hind margin. There are two distinct triangular-shaped black marks on costa, and a series of semicircular ones along the hind margin, which last is highly angulated and dentated. The basal half of hind-wings is gray, the outer half being rich brown; and there is a large round patch of this same colour at anal angle of fore-wings. The genus as well as species is new to science.

14. Idiodes apicata, *Gn.*

Expanse, 1′ 11″ to 2′. August, January, March.

One of the most variable insects I have met with; hardly two specimens are alike, and there appear to be four distinct types of markings. The fore-wings are sharp-pointed, and strongly hooked at apex, and there is generally a straight diagonal line running from apex across both wings to centre of inner margin of the hind one. In type 1 the ground is greenish, and stripe yellow. In type 2 the ground is reddish-brown, and stripe dark purplish-brown. In type 3 the whole of both wings is suffused with dark purplish-red, forming indistinct smeary blotches; while in type 4—which is by far the rarest—the ground is as in type 1, but on the outside of the yellow line are three large round bluish-black spots, with white centres; the two nearest the apex being nearly confluent. Some years this curious moth may be obtained plentifully by beating gum saplings, but the summer brood is always dwarfed in size, and some years the species appears to be absent altogether.

15. Mnesampela privata, *Gn.*

Expanse, 1′ 6″. March and April.

Fore-wings hooked; yellowish-brown, with a darker shade across fore-wing at half. Hind-wings bright orange. Common

16. Mnesampela comarcha, *Meyr.*

Expanse, 1′ 8″. April.

A good deal like the last superficially, but the ground colour of all the wings is a pale brownish purple. The antennæ of males also show a specific difference, and the insect appears later. This moth seems to be rare.

17. Mnesampela fucata, *Feld.*

Expanse, male, 2′ 4″. (I have never seen the female). May.

Fore-wings orange, speckled all over with minute purple spots. There are also three larger red spots—one at base, one at centre of wing near base, and the third below costa at about two-thirds. The hind-wings are pale primrose-yellow, without markings. The female is said to be larger and darker than the male. A rare insect everywhere.

18. Criomacha belidearia, *Feld.*

Expanse, 2′ 1″ to 2′ 5″. May.

Another variable insect, which may be separated into two distinct types, which remain good in both sexes. So distinct are they in appearance that I considered them different species, but Mr. Meyrick thinks otherwise, and so I place them together. In the first the wings are bright brick-red, without any distinct markings; in the other they are pale reddish brown, speckled all over with brownish-purple, and with a more or less distinct darker band across centre of wings. The hind wings are alike in all, reddish-white, inclining to purple on outer margin. Fairly common some years; absent others.

19. Criomacha eribola, *Meyr.*

Expanse, 2′ 4″. March.

Only one specimen of this species is known, a female, and it is just possible that it may be a very abnormal variety of *belidearia*, but it is such an entirely different looking insect that Mr. Meyrick decided to name it. The fore-wings are dark brown with a yellowish tinge; a black outward curved zigzag line crosses them at one-third, and another, nearly straight, at four-fifths. The thorax is the same colour as the wings, but the crest and head are orange, thus differing from *belidearia*, in all of which the head is the same colour as the wings. The hind-wings are pale yellow, with a deep reddish-brown border. The body is pale yellow.

20. Chlenias arietaria, *Gn.*

Expanse, 1′ 5″. March and April.

Fore-wings brown, suffused with silvery-gray in centre. Three narrow black streaks run from near base up the centre

of wing, the veins of which are also tinged with black, especially towards outer margin. The hind wings are pearly white. There is a curious hard bifurcated horn-like process on the front of head. A common insect. The male flies slowly just about day-break, but the female often comes to light.

21. Chlenias Zonæa, *Meyr.*

Expanse, 1′ 7″. April.

This species has, I believe, so far only been taken by myself at Balhannah, at any rate it was undescribed. It is larger, darker, and more glossy than *C. arietaria*, and is entirely destitute of the bifurcated horn on the head. The hind wings are sometimes smoke-coloured, sometimes white at base, with dark smoke-coloured margin. My specimens were all bred from the the larva, and I have only twice seen the perfect insect at large, and never on the wing.

Larva.—When full-fed about one inch in length, banded or striped as follows:—Orange stripe down centre of back; then four wavy black lines with bluish-white spaces between; then a broad primrose stripe; then four more black lines, the three last interrupted with space between yellowish white, and then a broad black line. Below this the body is yellow, with four purple wavy lines, spiracles distinct, orange, which latter colour predominates on all the broad stripes towards the head, which is yellow. Body smooth to the eye, but under the lens there are a few sparse black hairs; claspers only visible on the tenth and thirteenth segments. Feeds stretched out on food plant, but on the slightest touch rolls in a ring and drops to the ground. Feeds on Aster axillaris, and is full-fed in September, but although I tried to force them, not one would emerge before middle of April.

22. Stibaroma melanotoxa, *Meyr.*

Expanse, 1′ 5″.

This is a handsome silvery-grey moth, unknown to science until taken by myself. There is a narrow but sharply-defined black line at one-fourth, which is very acutely angulated outwards, and another broader and less acutely angulated at three-fourths. Outside this is a dark blackish smear. Hind wings silvery white, with dark broad border. My specimen is a male; but I possess also a darker insect (a female), that may belong to this species, but the markings are very different, and I am not sure.

23. Paralæa beggaria, *Gn.*

Expanse, 2′ 1″; female rather larger. April.

All the wings of the male are of a dark grayish-purple, but the hind-wings of female are whitish at base, purple outside.

There is a distinct black centre spot in the female, but this is nearly wanting in the other sex. Scarce here, and, I believe, everywhere else, but apparently widely distributed. It is one of the few insects that appear to have a preference for the red gum.

24. Drymoptila temenitis, *Meyr.*

Expanse, one inch. April 7, 1879.

This curious insect is as yet unique, and I have never been able to find a second. Both genus and species are new to science. Fore-wings purplish-gray, with a reddish cross line near base, and a curved and slightly indented black one running from costa at about four-fifths to near the anal angle. The space between this and the outer margin is chocolate colour. Hind-wings greyish brown.

The Lamellibranchs of the Older Tertiary of Australia. (Part II.)

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Plates XIV., XV., XVI., XVII., XVIII., XIX., XX.

Family Lucinidæ.

Genus Lucina.

SYNOPSIS OF SPECIES.

A. Shell more or less inflated.
- Ornament of concentric lamellæ or striæ.
  - Lamellæ thick.
    - Quadrately orbicular. *L. leucomomorpha.*
    - Obliquely ovate. *L. projecta.*
    - Concentrically striated; shell subglobose; margin of valve plain. *L. aræa.*
    - Margin of valves crenulated. *L. affinis.*
  - Ornament of concentric lamellæ and radial lines.
    - Globose with thick lamellæ. *L. nuciformis.*
    - Quadrately orbicular, bifid incised radial lines. *L. araneosa.*
    - Obliquely ovate. *L. despectans.*
  - Ornament of divaricate ridges. *L. quadrisulcata.*

B. Shell compressed.
- Ornament of lamellar folds. *L. fabuloides.*
- Ornament of radial threads and concentric lamellæ. *L. planatella.*

Lucina leucomomorpha, *Tate.*

Reference.—Tran. Roy. Soc., S. Aust., for 1885, t. xii., fig. 7.

Shell quadrately orbicular, moderately convex, subequilateral; umbones small, incurved, contiguous, medial; slightly excavated in front of the umbones, and slightly depressed in the antero-dorsal region; posterior margin truncated; ventral margin convex outwardly. Surface ornamented with numerous regular concentric lamellæ, which are slightly retroflexed at the front.

Lunule cordate, small, rather deep; anterior lateral teeth obscure; right valve with one small cardinal tooth, left valve with two cardinal teeth; ligamental scar linear, submarginal; edge of valve obscurely crenulated.

Dimensions.—Antero-posterior diameter, 11; umbo-ventral

diameter, 10·5; sectional diameter of both valves, 6 millimetres.

Locality.—Muddy Creek.

This species has a very strong external resemblance to *Loripes leucoma*, Turton, but is abruptly truncated posteriorly; the surface is lamellately ridged (not striated), and there are no radial striæ; the external ligament removes it generically.

Lucina projecta, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 6.

Shell thin, obliquely ovate, roundly truncated behind, broader with a rounded margin anteriorly; moderately convex. Lunule lanceolate, somewhat deeply depressed. The ornament consists of subacute close-set liræ.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 14; sectional diameter, 8 millimetres.

Locality.—Muddy Creek (older beds).

Lucina aræa, *spec. nov.* Plate xix., fig. 9.

Shell orbicular and somewhat oblique, moderately convex, thin, subequilateral; umbones acute, only a little elevated, incurved; lunule small, shortly lanceolate, and slightly sunken. Posterior-dorsal margin is short, straight, and rather sloping; the anterior-dorsal margin being longer, less oblique, and a little concave in front of the umbo; anterior and ventral margins broadly curved, whilst the posterior margin is roundly truncate. Ligament groove on the post-dorsal margin elongate and narrow. The right valve has two cardinal teeth, the front one being small, lateral teeth absent. Margin of valve plain. Surface ornamented with fine concentric striæ.

Dimensions.—Antero-posterior diameter, 8; umbo-ventral diameter, 6; sectional diameter of right valve, 2·5 millimetres.

Locality.—Oyster banks of the Aldinga Cliffs.

Lucina affinis, *spec. nov.* Plate xviii., fig. 11.

Shell subquadrately-rotund, moderately convex, subinequilateral; front-dorsal margin slightly concave, post-dorsal margin longer and sloping; posterior area slightly depressed, which produces a short truncated extremity to the margin; umbones prominently incurved. Margin of valve minutely crenulated. Left valve with two diverging cardinal teeth and developed laterals; ligamental groove on the hinder-dorsal edge long and narrow. Surface ornamented with concentric striæ.

This species is separable from *L. aræa* by its depressed posterior area, crenulated margin of the valves, and the presence of lateral teeth. It also bears an external resemblance to

Lucina concinna, Hutton (*Loripes*), but the ornament and some of the interior characters are different.

Dimensions.—Antero-posterior diameter, 6; umbo-ventral diameter, 5·5; sectional diameter of left valve, 1·75 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

Lucina nuciformis, *Tate.*

Reference.—Trans. R. Soc., S. Aust., for 1885, t. xii., f. 10.

Shell globose, very thick, regularly convex except in the post-dorsal area, which is abruptly compressed. Surface ornamented with subacute concentric ridges, broader than the intervening sulci, and distant transverse threads more or less obsolete, though usually conspicuous on the dorsal face of the concentric folds. The concentric ridges are usually regularly disposed, but in some individuals they are interrupted by from three to five broadish furrows, variable in width and relative position. Margin of valves, except the hinge-line, strongly crenulated. Lunule small, moderately impressed.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 9; sectional diameter, 8 millimetres.

Locality.—Very abundant in the oyster beds of Blanche Point, Aldinga Bay.

L. nuciformis has a general resemblance to *L. columbella*, Lamarck, but its nearest ally in recent creation is *L. crassilirata*, Tate, inhabiting Southern Australia, from which it differs by its greater gibbosity, more angulated behind, and thinner liræ.

Lucina araneosa, *spec. nov.* Plate xx., fig. 13.

Shell quadrately orbicular, subinequilateral, thin, subventricose; umbones acute, approximate, incurved; anterior side slightly produced; lunule moderately large, lanceolate, shallow. Surface ornamented with distant concentric striæ, and incised radial lines repeatedly dichotomous.

Dimensions.—Antero-posterior diameter, 8; umbo-ventral diameter, 7·5; sectional diameter of left valve, 2 millimetres.

Locality.—Muddy Creek, lower beds.

Lucina despectans, *spec. nov.* Plate xx., figs. 15 and 16.

Shell quadrately ovate, subventricose, inequilateral; umbones post-median, acute, incurved, and approximate. Dorsal margin slightly excavated in front, rapidly declining behind; posterior margin truncated; ventral margin arched, rounded in front, forming an obtuse angle where it joins the dorsal inflection.

Surface ornamented with concentric striæ and depressed subacute radiating ridges.

Diminsions.—Antero-posterior diameter, 5·5; umbo-ventral diameter, 5; sectional diameter 3 millimetres.

Locality.—Muddy Creek, lower beds.

This little species resembles *L. Tatei*, Angas (P. Z. S., 1878, p. 863), from St. Vincent Gulf, but differs in the style of ornament, and somewhat in form, being particularly less incurved on the antero-dorsal margin.

Lucina quadrisulcata, *D'Orbigny.*

Reference.—Voy. Amérique méridionale, 1847.

Synonyms.—*L. dentata*, auctores, non Wood; *L. divaricata*, auctores, non Linn.; *L. eburnea*, Reeve, Icon. Conch., t. 8, f. 49, 1850; *L. Cumingi*, A. Adams and Angas, Proc. Zool. Soc., 1863, p. 426, t. 27, f. 20.

The fossil which I have illustrated on Plate xii., f. 3, of Part I., under the name of *L. dentata*, does not belong to that species, but to *L. Cumingi*, Adams and Reeve, which in the opinion of Mr. A. H. Cooke (Ann. and Mag. Nat. Hist., Aug., 1886, p. 98) is identical with *L. quadrisulcata*, D'Orbigny.

This species is the largest of the section Divaricella, is more globose in form than the other species, with the divaricating grooves rather more distant, and not denticulated at the margin. It is found living in Ceylon, South Australia, Tasmania, Port Jackson, New Zealand, Gulf of Suez, West Columbia, Panama, and West Indies.

It is fossilized in the oyster beds of the River Murray Cliffs at the Nor'-West Bend; also in the Wanganui Series in New Zealand.

Lucina fabuloides, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 5.

Shell thin, oblong-ovate, compressed; triangular about the umbones, which are ante-median compressed and slightly curved forwards, but not incurved. Antero-dorsal line much incurved in front of the umbo; post-dorsal margin nearly straight, sloping at an angle of about 45°, united to the antero-dorsal side by a graceful curve, with a perceptible truncation posteriorly.

Surface ornamented with sixteen equidistant, erect, thin lamellæ, interspaces concentrically striated; the lamellæ more raised at the front and posterior margins, and the post-dorsal margin is somewhat serrated by them.

Lunule narrow-lanceolate, concave.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 7 millimetres.

Localities.—Oyster-banks at Blanche Point, Aldinga Bay; and the gastropod bed of the River Murray Cliffs near Morgan.

This fossil species closely resembles *L. spinifera*, Montagu,

of European seas, and *L. fabula*, Reeve, of the Australian and Polynesian seas, with actual specimens of which I have compared it; from *L. fabula* it differs by its fewer concentric ridges, which are thin and elevated, and by the deeper incurvature in front of the umbo; from *L. spinifera* it differs by its fewer concentric lamellæ and more pointed umbones.

Lucina planatella, *Tate.*

References.—Trans. Roy. Soc., Tasmania, for 1884, p. 229; Trans. Roy. Soc., S. Aust., for 1885, t. xii., fig. 11.

Left valve orbicular-ovate, subequilateral, moderately thin, nearly flat. Surface ornamented with regularly disposed concentric, erect, lamelliform ridges of growth, crossed by equidistant radial threads, producing on the dorsal half an open reticulated appearance; towards the front the concentric ridges are coarser, and the radial striæ finer or nearly obsolete. Umbo depressed acute; interior margin of valves smooth.

Dimensions.—Antero-posterior diameter, 33; umbo-ventral diameter, 31 millimetres.

Locality.—Table Cape (*R. M. Johnston!*)

Loripes simulans, *spec. nov.* Plate xiv., fig. 19.

Shell somewhat triangularly orbicular, subequilateral, thin rather inflated; umbones produced incurved; antero-dorsal margin conspicuously concave, post-dorsal margin about as long and sloping; posterior margin roundly truncated. In young shells the anterior side is somewhat produced. Margin of valves minutely crenulated. Surface ornamented with distant, slightly elevated, concentric lamellæ. The left valve has two small diverging cardinal teeth; the right valve with one cardinal tooth, and in each valve there is a post-lateral tooth; cartilage groove wholly internal, descending obliquely from behind the cardinal area.

Dimensions.—Antero-posterior diameter, 6·25; umbo-ventral diameter, 6; sectional diameter, 4 millimetres.

Locality.—Oyster banks, Aldinga Cliffs.

Differs from *L. icterica*, Reeve, in the well-developed concentric ridges, and in the absence of radial striæ, in which respect it agrees with *L. assimilis*, Angas. From the latter species, which I have not seen, it seems to differ by its coarser concentric ornament and inflated umbones.

Cryptodon mactræformis, *spec. nov.* Plate xix., fig. 5.

Shell minute, very thin, triangularly ovate, inequilateral, moderately convex, semipellucid, white, shining. The sculpture consists of very fine striæ of growth. Umbones small, only a very little elevated above the dorsal line, acute, situated somewhat in advance of the middle. The posterior side is a little

produced, being a little longer than the anterior, and is acuminate behind. The dorsal margins are straight and very sloping, especially the posterior, which is a little longer than the anterior; the ventral margin is regularly curved.

Dimensions.—Antero-posterior, 3·5; and umbo-ventral diameters, 2·75 millimetres.

Locality.—Lower beds at Muddy Creek.

FAMILY UNGULINIDÆ.

Diplodonta subquadrata, *spec. nov.* Plate xiv., figs. 10*a*—10*b*.

Shell quadrately-orbicular, moderately convex, thin, translucent, inequilateral, equivalve; posterior side broad, with a subtruncated margin, anterior side narrower and rounded. The ornament consists of rather coarse concentric lines of growth, with here and there broader ones. Umbones small, antemedian, acute.

Dimensions of an average size specimen:—Antero-posterior diameter, 13; umbo-ventral diameter, 11·5; sectional diameter, 9 millimetres.

Localities.—Muddy Creek (lower beds); oyster-beds of the River Murray Cliffs at Nor'-West Bend; Table Cape, Tasmania (*R. M. Johnston!*)

The nearest ally of this species is *D. Tasmanica*, T. Woods, from which it differs by its more quadrate outline and regular sculpture, and in being less inequilateral; it closely resembles, also, *D. Zealandica*, Gray, which is more inflated, and has a rounded ventral margin.

Sacchia suborbicularis, *spec. nov.* Plate xviii., figs. 10*a*—10*c*.

Shell triangularly orbicular, depressed, rather solid; posterior side rounded, somewhat produced anteriorly. Umbones small, obtuse, produced, approximate; lunule obsolete, margins of valves simple. Surface marked with distant growth-folds, smooth at the umbones.

The left valve has two divergent cardinal teeth; the anterior one is stout and triangular, the posterior one is thin and elongate, behind which is a broad and deep triangular cartilage groove. In the right valve there are two cardinal teeth separated by a triangular pit, which receives the strong anterior tooth of the left; the anterior tooth is confluent with the dorsal edge, but the posterior is elongate, narrowly triangular, grooved on the face, and free from the dorsal edge; there is a cartilage groove corresponding with that in the left valve. No lateral teeth. Pallial line entire.

Dimensions.—Antero-posterior diameter, 7·5; umbo-ventral diameter, 8; sectional diameter, 3·75 millimetres.

Locality.—Oyster-beds of the River Murray Cliffs at the Nor'-West Bend.

It is with some hesitation that I refer this little species to *Sacchia*, as I have had no opportunity of examining an authentic species of this genus, also because of the great resemblance it bears externally to the lenticular species of *Diplodonta*, particularly *D. Adamsi* and *D. Jacksonensis*, Angas; but the dentition and the broad cartilage pit are not those proper to *Diplodonta*.

FAMILY ERYCINIDÆ.

Leptum crassum, *Tate.*

Reference.—Trans. Phil. Soc., Adelaide, 1879, t. 5, f. 9, p. 130.

A thick transversely-oval shell.

Locality.—Gastroped bed of the River Murray Cliffs, near Morgan.

Lepton planuisculum, *Tate.*

Reference.—Op. cit., t. 5, f. 12, p. 130.

A thin quadrately-ovate shell, with a produced umbo.

Locality.—Oyster beds of the Aldinga Cliffs.

Kellia micans, *spec. nov.* Plate xix., fig. 13.

Shell minute, inequilateral, rather thick, convex; umbones small, depressed; anterior side somewhat produced; posterior side shorter, roundly truncated at the extremity; the dorsal margin is considerably oblique on both sides; there is no lunule. Surface smooth and shining, and ornamented with concentric striæ; alternating bands of varying width of opaque white and bluish-slate colour. Left valve with one small cardinal denticle, in front of which is a stout laminar tooth; there is also a faint short lateral tooth on the posterior side.

Dimensions.—Antero-posterior diameter, 3; umbo-ventral diameter, 2·5; sectional diameter of left valve nearly 2 millimetres.

Locality.—Muddy Creek.

Montacuta sericea, *spec. nov.* Plate xiv., fig. 6.

Shell transversely ovate, moderately depressed, very inequilateral, rather solid, glossy, and sculptured with very fine lines of growth. The umbones are small, curved over towards the front, slightly produced, and situated at about one-fourth of the total length from the anterior end. The anterior-dorsal margin is short, oblique; imperceptibly excavated before the umbo, then gradually rounding into the sharply-curved extremity; the post-dorsal margin is much longer, at first almost horizontal and straight, afterwards a little arched and oblique. The ventral margin is nearly horizontal. The left valve has

two divergent laminar teeth, one on each side of a broad triangular cartilage pit, of which the posterior is large and oblique, and the anterior very small. The right valve has a lamellar projection of the dorsal margin on either side of the cartilage-fossula.

Dimensions.—Antero-posterior diameter, 6·5; umbo-ventral diameter, 5; sectional diameter, 3 millimetres.

Localities.—Upper beds at Muddy Creek; oyster beds of the River Murray Cliffs at the Nor'-West Bend.

FAMILY CHAMIDÆ.

Chama lamellifera, *Tenison-Woods.* Plate xiv., figs. *5a*—*5b*.

Reference.—Proceedings of Royal Society of Tasmania for 1876, p. 114.

Surface of both valves ornamented with distant, thin, irregular, sometimes projecting lamellæ. The lamellæ are finely radiately ridged and striated; interspaces between the lamellæ concentrically striated. Rarely exceeding 20 millimetres of diameter.

Localities.—Table Cape (*R. M. Johnston!*); older and younger beds at Muddy Creek; clays at Schnapper Point; well sinking, Nine-Mile Camp, near Nor'-West Bend; clayey sands, Adelaide bore.

Chamostrea albida, *Lamarck.*

Reference.—Animaux sans Vertebres, vol. vi., p. 96, 1819.

Synonym.—*C. crassa*, Tate, Proc. Roy. Soc., Tasmania, for 1884, p. 228.

I do not hesitate to refer an example of a large valve obtained by Mr. Dennant from the Muddy Creek beds to the above-named species of the peculiar Australian genus. A left valve collected by Mr. R. M. Johnston at Table Cape was erected by me into a distinct species, but I think now on insufficient grounds.

Right very convex, keeled, attached by its anterior side; umbo anterior subspiral; left valve flat; surface smooth, with distant growth-lines. About two inches diameter.

FAMILY VERTICORDIIDÆ.

Verticordia rhomboidea, *spec. nov.* Plate xiv., fig. 4.

Considerably inflated, rhomboid, very inequilateral. Umbo inflated, much curved over towards the front, and situated quite at the anterior end; the ventral margin nearly straight, the dorsal margin arched, making with the straight posterior margin an obtuse angle; anterior margin at first concave, forming a rounded somewhat produced angle with the ventral margin.

Surface ornamented with thin, angular, elevated, curved, radial ribs, 24 in number, eight of which occupy the abruptly sloping post-umbonal area, insterstices wider than the ribs; the whole surface crossed by thin distant concentric liræ, which produce serratures on the radial costæ.

Lunule deep and broadly cordate.

Interior pearly, ribbed towards the ventral and posterior margins corresponding with the exterior sulcations; anterior and posterior margins thin, crenulated.

Right valve with a tooth-like callosity under the lunule, and a long laminar lateral tooth on the posterior side.

Dimensions.—Antero-posterior diameter, 5; umbonal ventral diameter, 5; sectional diameter of right valve, 2·25 millimetres.

Locality. — Calciferous sandstone, with gastropods, River Murray Cliffs, near Morgan.

Verticordia pectinata, *spec. nov.* Plate xiv., fig. 13.

Triangularly ovate, slightly convex; anterior side somewhat produced and rounded; umbo small, curved towards the front, situated a little behind the middle line; front dorsal margin concave, post-dorsal margin convex, gibbous; ventral margin slightly arched medially, rapidly ascending posteriorly to the subacuminate extremity. Ornamented with twelve broad, rounded, radial undulations about equal in breadth to the concave furrows; the whole surface minutely granular, which is produced by the intersection of radial and concentric striæ. Interior of left valve pearly, edentulous; ventral margin of valve thin, broadly crenulated.

Dimensions.—Antero-posterior diameter, 3·5; umbo-ventral diameter, 3 millimetres.

Locality.—Lower beds at Muddy Creek.

FAMILY CARDIIDÆ.

Genus Cardium.

SYNOPSIS OF THE SPECIES.

Whole surface ornamented with more or less similar radial ribs.

A. Valve rotundly-quadrate.
  Ribs, 50, flat, and smooth. *C. pseudomagnum.*
  Ribs, 70, flat, and smooth; those on the posterior slope with small tubercles. *C. septuagenarium.*
  Ribs, 60, flat, granulated on the margins. *C. moniletectum.*

B. Valve ovate, oblique; 65 ribs. *C. Victoriæ.*

C. Valve trapezoidal. *C. cuculloides.*

Radial ridges on the posterior slope only, rest of surface radially and concentrically striated. *C. antisemigranulatum.*
Anterior half of valve cancellated, the posterior half with spinulose ribs. *C. hemimeris.*

Cardium pseudomagnum, *McCoy.*

Reference.—Pal. Victoria, Decade v., t. 44, f. 1, 1877.

"Rotundly quadrate; ribs 50, sub-equal, flat, smooth, without spines or marked striæ, and separated by very narrow sulci, their ends strongly toothing the internal margin. Length of the antero-posterior diameter, 90 millimetres. *Locality.*—Very abundant in the sandy beds, Bird Rock Bluff, near Geelong."—*McCoy.*

Cardium moniletectum, *spec. nov.* Plate xiv., figs. 3*a*.—3*b*.

Rotundly quadrate, slightly oblique, subequilateral, ventricose; ventral margin moderately convex; posterior slope flattened, becoming a little convex dorsally, its margin straight, nearly perpendicular; post-dorsal margin nearly straight, slightly ascending; front dorsal margin straight, a little sloping, joining somewhat abruptly the flatly rounded anterior margin. Umbo inflated, moderately oblique, and a little in front of the centre.

Ribs, about 60, equal, flat, smooth, shining, minutely, closely and regularly granulated on the margins; intervening sulci very narrow and deep. Margin of valves strongly toothed.

Dimensions.—Antero-posterior diameter, 38; umbo-ventral diameter, 40; sectional diameter through closed valves at about half the length from the umbo, 31 millimetres.

Locality.—Abundant in the clayey green sands, Adelaide bore.

Cardium septuagenarium, *spec. nov.*

Shell of about the same size and shape of *C. moniletectum*, but with about 70 flat, smooth, slender ribs, those of the posterior slope crowned with small tubercles; the intervening sulci nearly as broad as the ribs, shallow, and transversely finely striated.

Localities.—Table Cape *(R. M. Johnston!)*, and in a well-sinking at Nine-Mile Camp, near Nor'-west Bend, River Murray Plain.

Cardium Victoriæ, *spec. nov.* Plate xiv., figs. 1*a*—1*b*.

Shell longitudinally ovate, somewhat heart-shaped, rather depressed, slightly oblique, subequilateral. Ornamented with about 65 delicate, flattish, radial costæ; costæ with distant decurrent serratures on their sides, those on the anterior side with elevated, thick, distant, annular scales or tubercles; six

or seven costæ on the posterior slope tuberculated; the intervening sulci are about as wide as the ribs.

Umbo obtuse, incurved, with a slight forward projection. The front and post-dorsal margins about equally sloping; the posterior area is flattened, its margin obliquely truncated.

Margin of the valves crenulated.

Dimensions.—Antero-posterior diameter, 15; umbo-ventral diameter, 16; sectional diameter of a single valve at about one-third the length from the umbo, 5 millimetres.

Locality.—The older beds at Muddy Creek, near Hamilton, Victoria.

Cardium cuculloides, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., for 1885; plate xii., fig. 14.

Shell thin, smooth, trapezoidal, oblique, tumid, inequilateral; umbones oblique, incurved, narrow, considerably in front. Anterior margin rounded; ventral margin nearly straight, oblique to the hinge line; posterior margin obtusely truncated; posterior slope flattened, separated from the moderately convex rest of the valve by an obtusely-rounded ridge; dorsal line arched.

Surface ornamented by equidistant, incised radial lines, about one millimetre apart at the front; in the umbonal region the sulci are about half the width of the flat ridges; on the lateral areas the sulci, though narrow, are deep and obliquely striated; the flat ridges are marked in the middle line by a slight groove widening out at irregular intervals into elliptical depressions. Inner margin of valve flatly ribbed.

Dimensions.—Longitudinal diameter, 32; length from umbo to posterior angle, 31; width, 30; thickness through both valves, 20 millimetres.

Locality.—Muddy Creek (*J. Dennant !*).

This remarkable species may be placed in the section *Papyridæ* of Swainson.

Cardium antisemigranulatum, *McCoy.*

Reference.—*Protocardium antisemigranulatum*, McCoy, Pal. Victoria, Decade v., t. 44, figs. 2-3, 1877.

Quadrately-oval, gibbous; umbo elevated, incurved, and directed forwards; posterior slope with acute radial ridges, closely set with conical tubercles; rest of the surface regularly, concentrically, and radially striated.

Dimensions.—Antero-posterior diameter, 40; umbo-ventral diameter, 42; sectional diameter of a single valve, 16 millimetres.

Localities.—Rare at Moorabool (*McCoy*); very rare in the older beds at Muddy Creek (*J. Dennant !*).

Cardium hemimeris, *spec. nov.* Plate xiv., figs. 2*a*—2*c*.

Shell thin, quadrately-oval, subglobose, inflated; umbones elevated, incurved, submedian; dorsal margin slightly arched; posterior margin truncated, a little incurved towards the lower rounded angle; posterior area flattened, very steep. The anterior half of the surface of the valve is ornamented by numerous regular, equal, flat riblets, crossed by finer and closer concentric threads, which are somewhat irregularly disposed, being here and there somewhat undulose and confluent;* the intersection of the riblets and the liræ produce a tessellated ornament. The posterior half is ornamented with about 50 flat, narrow riblets, closely beset with small tubular, conical spines. Margin of the valves strongly toothed.

Dimensions.—Antero-posterior diameter, 13; umbo-ventral diameter, 14; sectional diameter of both valves, 10 millimetres.

Localities.—Very common in the clayey green sands, Adelaide bore; rather rare and of small size in the older beds at Muddy Creek; in a deep well-sinking, Cooke's Plains, east of Wellington, River Murray.

FAMILY UNIONIDÆ.

The generic references to the following species were made by the original describer purely on external resemblance, which is of no value. As *Anodonta* is not actually known either recent or fossil in Australia, and *Unio* is, it will be more consistent therefore to place all our fossil Unionidæ, so long as the hinge characters are unascertained, in the latter genus.

Unio Tamarensis, *R. Etheridge, jun.*

Reference.—*Anodonta Tamarensis*, Eth., Roy. Soc., Tasm., for 1880, p. 22, figs. 3-4.

Older Tertiary beds of the Tamar River, Launceston, on the authority of Mr. R. M. Johnston.

Transversely elongate, about twice as long as broad; posteriorly acuminated, anterior side very short, convex, and very gibbous; length, nearly four inches.

Unio Johnstoni, *R. Etheridge, jun.*

Reference.—Op. cit., p. 20, figs. 1, 2.

Same locality as the last.

Obliquely oval, compressed; breadth, about one-third less than the length, which is three and a-half inches.

---

* The fig. 2*b* incorrectly represents the concentric sculpture.

FAMILY VENERIDÆ.

Genus Chione.

SYNOPSIS OF THE SPECIES.

A. Lamellæ thin, erect.
  a. Lamellæ distant, interspaces concentrically striated.
    Shell ovately-oblong, anterior side subangulated; lamellæ, about twelve. *C. Allporti.*
    Anterior side rounded; lamellæ numerous. *C. multilamellata.*
  b. Lamellæ distant, interspaces with radial riblets.
    Cordately ovate, ventricose. *C. hormophora.*
    Ovately-oblong, less inflated. *C. dimorphophylla.*
  c. Lamellæ crowded; cordately ovate. *C. Cainozoica.*
B. Lamellæ thick, or concentrically ridged.
  Trigonal, with fifteen lamellæ. *C. subroborata.*
  Transversely oval, with twenty or more ridges, radially striated. *C. propinqua.*
C. Surface with radial riblets, decussated by concentric striæ. *C. dictua.*
D. Surface smooth, concentrically grooved. *C. Corioensis.*

Chione Allporti, *Tenison-Woods.*

Reference.—*Venus Allporti*, Tenison-Woods, Proc. Roy. Soc. Tasmania for 1875, p. 26, t. 3, f. 10.

Ovate, oblong, depressed; anterior side very short, its margin somewhat angulated; ornamented with twelve concentric appendiculate lamellæ, and concentric striæ; the ventral aspect of the frills is slightly vertically wrinkled. Margin of the valves minutely crenulated.

Dimensions.—Antero-posterior diameter, 30; umbo-ventral diameter, 22 millimetres.

Locality.—Table Cape (type in Hobart Mus. !)

This fossil differs from the living *C. lamellata* by its more oblong outline, the post-dorsal and ventral margins being nearly parallel, whilst the anterior margin is more rapidly descending, and the ventral margin not so arched; the umbo is more anterior, and the frills are simple, and about twice the number.

Chione multilamellata, *spec. nov.* Plate xv., figs. 6*a*—6*b*.

Ovately-oblong, thin, moderately convex; umbones antemedian, inflated, curved forwards; anterior margin rounded, posteriorly roundly truncated; ventral margin regularly arched; post-dorsal margin slightly arched, more rapidly sloping than the shorter, nearly straight front dorsal margin. Lunule broadly cordiform, much raised along the middle line, and sculptured with fine lamellæ of growth.

The surface is closely lamellated, concentrically lirate and

substriated in the interstices, and radiately striated, more conspicuously so on the posterior and anterior sides; the lamellæ are about 40 in number, thin, elevated, and radially ribbed and striated on the ventral aspect.

Margin of the valves from the umbo to the post-ventral angle minutely crenulated. Siphonal inflection very short, broadly triangular.

Dimensions of a moderate-sized specimen.—Antero-posterior diameter, 38; umbo-ventral diameter, 30; sectional diameter through both valves, 22 millimetres.

Localities.—Abundant in the Turritella clays at Blanche Point, Aldinga Bay, and in the clayey green sands in the Adelaide bore.

C. multilamellata bears considerable resemblance to *Venus oblonga*, Hanley, but is not so rounded posteriorly and the lamellæ are higher and thinner.

Chione hormophora, *Tate.* Plate xv., figs. 1*a*—1*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

Shell solid, cordately-ovate, inflated; truncately rounded in front, truncated behind; ventral margin arched; post-dorsal margin strongly arched, antero-dorsal margin straight. Surface ornamented with numerous concentric lamellæ thickened and recurved, becoming erect and thin towards the posterior and anterior margins; the interstitial spaces with numerous flattish radial ridges, about equal in breadth to the intervening sulci, which are continued on to the bases of the concentric folds, and to the the free margin of the frills on their undersides. Lunule cordate, not much impressed under the umbo, and indistinctly margined. The umbo is in the anterior-fifth, large, incurved, and directed forwards. Inner margin of valves, excepting that of the post-dorsal region, is minutely crenulated. Posterior cardinal tooth in left valve is quadrate and bituberculated on the crown. Pallial sinus short, broadly triangular, apex acute.

Dimensions.—Antero-posterior diameter, 65; umbo-ventral diameter, 57; sectional diameter of left valve, 22 millimetres.

Locality.—Table Cape (*R. M. Johnston !*)

Chione dimorphophylla, *Tate.* Plate xv., figs. 3*a*—3*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 230.

Similar to *C. hormophora*, but is more regularly rounded at the front, is less inflated, the umbo placed more posteriorly; the lunule is more impressed and concave; and the relative dimensions are different.

Dimensions.—Antero-posterior diameter, 58; umbo-ventral diameter, 45; sectional diameter of both valves, 32 millimetres.

Localities.—Common in the calciferous sandstone of the River Murray Cliffs, near Morgan; and in the older beds at Muddy Creek, near Hamilton.

Chione Cainozoica, *Tenison-Woods.* Plate xvi., figs. 3*a*—3*b*.

Reference.—Proc. Roy. Soc., Tasmania, for 1876, p. 113.

Suborbicular, inequilateral, globosely convex. Ornamented with closely set, thin, concentric lamellæ; those on the middle portion scarcely elevated; more elevated on the front, and imbricating posteriorly. Umbones convex, much incurved, and directed forwards; lunule broadly heart-shaped, prominent, and very distinctly circumscribed by a groove which interrupts the concentric lamellæ, the fine ends of which form the only ornamentation of the lunule.

The whole anterior and ventral margin finely crenulated. Pallial sinus very short, narrowly triangular, apex acute.

Dimensions.—Antero-posterior diameter, 22; umbo-ventral diameter, 20; sectional diameter of closed valves at about a third the length from the umbo, 14 millimetres.

Localities.—Table Cape (*R. M. Johnston!*); lower beds at Aldinga and Adelaide bore; middle Murravian beds near Morgan and Nine-mile Camp; lower beds at Muddy Creek clays at Schnapper Point, Port Phillip Bay.

Chione subroborata, *spec. nov.* Plate xiv., fig. 17.

Cordately-trigonal, solid, much broader in front than behind, where it is subrostrate, thick, moderately convex; flattened in the umbonal region. Umbones small, recurved, and situated considerably in front of the middle line. Surface glossy, ornamented with concentric lamellæ (about 15) and striæ; the lamellæ are rather thick, recurved, except on the posterior slope, where they are erect.

The ventral margin is broadly curved, slightly insinuate towards the posterior end; the post-dorsal line is oblique, arched behind the umbones, then straighter, prolonged, and much descending; the front-dorsal line is excavated.

The lunule is small, broadly cordate, and lamellate sculptured. The margin of the valves is very finely crenulated. Pallial line distant from the margin; the inflection rather shallow, broadly triangular, subacute at the apex.

Dimensions.—Antero-posterior diameter, 25; umbo-ventral diameter, 24; umbo to post-ventral angle, 25; sectional diameter of both valves, 14 millimetres.

Localities.—Common in the upper beds at Muddy Creek; oyster beds at Nor'-West Bend; calciferous sandstone at Mordialloc.

This species comes very near to *C. roborata*, Hanley, but the lamellæ are fewer and thinner; it is less produced anteriorly,

with a straighter post-dorsal slope, and more pointed behind. It agrees with *C. Isabellæ* in the number and strength of the lamellæ, but is otherwise different.

Chione propinqua, *Tenison-Woods.* Plate xiv., figs. 7 and 8.

Reference.—Proc. Roy. Soc., Tasmania for 1876, p. 113.

Transversely oval, umbo a little in front of the centre; anterior end broadly rounded; posterior side a little attenuated, its margin roundly truncated. Ornamented with many (more than 20) raised rounded concentric ribs, becoming lamellar at the extremities; ribs and the narrower interspaces are concentrically striated; the interspaces crossed by transverse broadish riblets, equal in width to the intervening spaces. Margin of the valves finely crenulated. Pallial line near the margin, the siphonal inflection rather shallow, narrowly triangular, rounded at the apex.

The species varies somewhat in shape and in the number and thickness of the concentric ribs; fig. 8 represents the typical form, fig. 7 represents a more oblong and narrower shell, whilst others are more attenuated than the type, even becoming subrostrated.

Tenison-Woods compares his species with the existing *C. conularis*, but the greater affinity is with *C. mesodesma*, Quoy and Gaimard, from which it differs most conspicuously by the coarser radial ornamentation.

Dimensions of the type.—Antero-posterior diameter, 24; umbo-ventral diameter, 19; sectional diameter of one valve, 6 millimetres.

Localities.—Table Cape (*R. M. Johnston!*); lower and upper beds at Muddy Creek, but common in the latter only.

Chione Corioensis, *spec. nov.* Plate xvi., fig. 1.

Sub-quadrately ovate, sub-depressed, inequilateral; umbo small, situated in the anterior third; anterior side narrowed, abruptly rounded; posterior side broader, and obliquely rounded at the end; the post-dorsal margin is horizontal and straight; ventral margin much ecurved. Lunule ill-defined.

Surface smooth and shining, with distant linear concentric sulci, the intervening flat sub-imbricating interspaces, becoming thread-like at the front and the two extremities; a few indistinct fine radial corrugations appear towards the antero-ventral margin. Angulated lines of colour are visible in the umbonal and median regions. Margin of valves plain.

Dimensions.—Antero-posterior diameter, 7·25; umbo-ventral diameter, 6·75.

Locality.—In the calciferous sandstone at Corio Bay, Geelong.

This species bears a strong resemblance to the young of

C. strigosa, but is proportionately shorter, the concentric ridges are flat, and not at all undulose.

Chione dictua, *spec. nov.* Plate xvi., fig. 2.

Transversely-oblong, inequilateral, rather depressed, broadly rounded in front, narrowed and obliquely truncate behind. Umbo acute, incurved, directed forward, situated in the anterior third; dorsal margin about equally sloping on both sides, straight behind, and feebly concave in front of the umbo. Surface ornamented with flat closely-set riblets somewhat irregular in thickness, but always wider than the linear interspaces, and decussated by concentric striæ and raised threads, more distant from each other than are the radial riblets, the concentric threads acquire the form of thin slightly elevated lamellæ at the two extremities. Lunule lanceolate, slightly concave, and medially elevated, sculptured with fine lamellæ of growth and circumscribed by a deep groove. Margin of valves, except post-dorsal, finely crenulated.

Dimensions.—Antero-posterior, 10; umbo-ventral, 7; and sectional diameter of both valves, 3·5 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

C. dictua has some affinity to *C. striatissima* and to young examples of *C. gallinula*, but the shape is different, and the sculpture very much finer.

Genus Cytherea.

SYNOPSIS OF SPECIES.

A. Lamellate rugæ on the posterior slope.
  Transversely-ovate, acuminated posteriorly. *C. paucirugata.*
  More triangular, truncated behind. *C. Murrayana.*
B. Smooth.
  Transversely-oval, somewhat produced and truncated behind. *C. tenuis.*
  Ovately-trigonal, rounded behind. *C. eburnea.*
  Oval, subacuminated posteriorly. *C. submultistriata.*

Cytherea paucirugata, *spec. nov.* Plate xiv., fig. 14.

Transversely-ovate; somewhat acuminate at both ends, especially behind; very inequilateral, moderately convex, thick; the front-dorsal slope is straightish, or a little incurved at the lunule, and much more descending than the post-dorsal margin, which is at first broadly curved, finally narrowly obliquely truncated; the ventral margin is widely arched, but is indistinctly sinuated in front of the post-ventral angulation.

The umbones are small, approximate, situated about one-

fourth of the entire length of the shell from the anterior end. The lunule is narrow-lanceolate, ill-defined, faintly circumscribed, and slenderly striated. The exterior of the valves is somewhat shining, coarsely concentrically striated, and bears a few remote concentric ribs, which are raised into scale-like lamellæ at the front margin and on the posterior slope, appearing on the latter in two rows, corresponding with the two obscure ridges, which proceed from the umbo to the angles of the posterior truncation. Ventral margin finely crenulated.

Dimensions.—Antero-posterior diameter, 39; umbo-ventral diameter, 30; sectional diameter of both valves, 21 millimetres.

Locality.—Very common in the younger beds at Muddy Creek, Hamilton.

This species closely resembles the living *Callista Victoriæ*, Tenison-Woods (=*Chione rutila*, Hanley), from which it differs by being proportionately longer, by the more acuminate and biangulated posterior extremity, by the flatter posterior slope, which is usually ornamented with two rows of elevated scales.

Cytherea Murrayana, *spec. nov.* Plate xiv., fig. 18.

Perhaps only an extreme form of *C. paucirugata*, nearly as broad as long; more widely truncated, and not at all acuminated posteriorly; the scale-like lamellæ small and developed on the anterior and post-dorsal margins only; the posterior slope is more angulated, and the lunule is much wider and deeper. Faint and distant radial threads are here and there visible on the surface.

Dimensions.—Antero-posterior diameter, 32; umbo-ventral diameter, 29 millimetres.

Locality.—Oyster beds of the River Murray Cliffs at Nor'-West Bend.

Cytherea tenuis, *spec. nov.* Plate xiv., fig. 16.

Transversely-oval, thin, moderately convex, inequilateral, a little narrower in front than behind, where it is somewhat truncated. The umbo is rather small incurved, situated at about one-fourth of the whole length from the front. The post-dorsal margin is elongate, nearly straight, the anterior being much shorter, more descending, and slightly curved; the ventral outline is gently arcuate, ascending more in front than behind. The lunule is broadly lanceolate, shallow, striated, and circumscribed by an impressed line. The exterior surface is shining, very finely concentrically striated.

The margin of the valves is plain.

The pallial sinus is large, broad, deep, obliquely ascending, extending to the centre of the valve, abruptly rounded at the end.

Dimensions.—Antero-posterior diameter, 27 ; umbo-ventral diameter, 20; sectional diameter of both valves, 13 millimetres,

Locality.—In the clayey green sands, Adelaide bore.

Cythera eburnea, *spec. nov.* Plate xviii., fig. 7.

Ovate-subtrigonal, inequilateral, rather thin and convex, sub-acuminate anteriorly, and bluntly rounded posteriorly. The umbones are rather small, moderately acute, curved over towards the front, situated at about one-third of the whole length from the front. The dorsal margin descends considerably on both sides, the anterior nearly straight, the posterior much longer, and slightly arched ; the ventral outline is gently curved, ascending much more in front than behind. Lunule, large, broadly cordate, scarcely sunken, a little elevated along the middle, circumscribed by an impressed line, and striated by growth lines.

The exterior is smooth, shining, white, marked at intervals with narrow subtranslucent zones, and ornamented with a few incised lines and striæ, developing into raised threads at the extremities.

The pallial sinus is moderately deep, obliquely ascending, and sharply rounded at the end.

The margin of the valves is plain.

Dimensions.—Antero-posterior diameter, 16 ; umboventral diameter, 13 ; sectional diameter of both valves, 10 millimetres.

Localities.—Common in the older beds at Muddy Creek, and in the calciferous sandstone of the River Murray Cliffs near Morgan ; also in the yellow sand rock, Corio Bay ; in the blue clays at Schnapper Point, Port Phillip ; Table Cape (*R. M. Johnston !*).

Cytherea submultistriata, *spec. nov.* Plate xviii., figs. 6 and 8.

Transversely elongate-ovate, moderately convex, thick ; anterior side shorter ; posterior side subacuminately produced. Surface with distant growth folds and finely concentrically striated. Lunule lanceolate, shallow, defined by an impressed line. The pallial line is much nearer to the margin than in allied species ; the sinus is wide and deep, reaching to the centre of the valve ; it is obliquely narrowly truncated at the end.

Dimensions.—Antero-posterior diameter, 30 ; umbo-ventral diameter, 22 ; sectional diameter of both valves, 14 millimetres.

Localities.—Upper beds at Muddy Creek ; variety (fig. 6), in a well-sinking, Cooke's Plains, east of Wellington, River Murray.

This species resembles the living *C. multistriata*, Sow., *C. disrupta*, Sow., and *C. Diemenensis*, Hanley; in its oval outline it comes nearest to *C. multistriata*, but its post-dorsal margin is straight, and the pallial line and sinus are different, being like those in *C. disrupta*.

The variety (fig. 6), of which only one specimen has been obtained, makes some approach to *C. eburnea;* it is shorter and more convex than the type, but is connected with it by two examples from Muddy Creek.

Genus Dosinia.

synopsis of species.

Regular concentric ridges.	
Valve flat; ridges thick, depressed.	*D. Johnstoni.*
Valve rather tumid; ridges thin, erect.	*D. Grayii.*
Inequidistant concentric sulcations.	*D. imparistriata.*

Dosinia Johnstoni, *spec. nov.* Plate xiv., figs. 9 and 12.

Orbicular, lenticular, moderately convex, somewhat thin and glossy, inequilateral.

Umbones moderate, curved forward, and situated at about one-fourth of the whole length of the valve from the front. Lunule ovately-cordate, short, impressed, elevated in the middle, very finely striated.

The exterior is ornamented with concentric ridges, which are regular, numerous, thick, depressed, with reflexed acute edges, and separated by linear deep sulci (about 20 in a breadth of 10 millimetres, measured from the ventral margin); at the extremities the liræ are fewer, and are here and there raised into more or less elevated scales. The posterior hinge area somewhat angulated and lamellated.

The pallial sinus is triangular, with a broad base, extending horizontally to a little beyond the middle of the valve; apex acute.

Dimensions.—Antero-posterior diameter, 27; umbo-ventral, 25; sectional diameter of one valve, 7 millimetres.

Localities.—Upper beds at Muddy Creek, Hamilton; Table Cape (*R. M. Johnston!*)

Dosinia Grayii, *Zittel.*

Reference.—Pal. von Neu-Seeland, p. 45, t. 15, f. 11; *id,* Hutton, Tertiary Moll. of N. Zealand, p. 22, 1873.

"Orbicular, solid, tumid, sub-æquilateral, with distant concentric lamellæ, more elevated at the extremities. Umbos inflated, incurved, acute. Anterior side sloping, rounded posteriorly; lunule large, oblong-cordiform, deeply impressed,

striated, circumscribed by an acute edge. Pallial sinus triangular, apex acute."—*Zittel.*

Dimensions.—Antero-posterior and umbo-ventral diameters, 60; sectional diameter of united valves, 40 millimetres.

Locality.—Yellow limetone of the sea cliffs at Edithburgh on west side of St. Vincent Gulf; also the Pareora and Wanganui formations, New Zealand.

This identification is based on the comparison with an authentic specimen of the species.

Dosinia imparistriata, *spec. nov.* Plate xiv., fig. 11.

Orbicular-cordate, rather gibbous, somewhat thin and glossy, inequilateral. Umbones rather large, curved forward, and situated at about one-third of the whole length from the front. Lunule short and narrow, medially elevated, ornamented with imbricating lamellæ.

The exterior is ornamented with linear concentric sulci at variable distances from one another; at the extremities the interspaces are raised into thickish, but little elevated lamellæ. The posterior hinge area is somewhat flatly rounded.

The pallial sinus is broad, obliquely ascending to a little beyond the middle of the valve, apex obtuse.

Dimensions.—Antero-posterior diameter, 13; umbo-ventral diameter, 12; sectional diameter of one valve, 4.

Locality.—Clayey green-sand, Adelaide bore.

This species is remarkable for the inequidistant concentric sculpture.

Meroe gibberula, *spec. nov.* Plate xv., figs. 4*a*—4*b*.

Ovate-cordate, subequilateral, slightly convex, and rather swollen behind the umbo; thick, polished; umbo acute, directed forwards, a little in front of the centre; posterior side broader and truncately rounded, anterior side produced, acuminately rounded. Margin of the valves closely and finely crenulated.

Dimensions.—Antero-posterior diameter, 28; umbo-ventral diameter, 23; sectional diameter of united valves, 13 millimetres.

Locality.—Common in the upper beds, Muddy Creek.

This species very closely resembles the living *M. Aliciæ*, Angas, from which it differs by being more gibbous in the post-dorsal region, and in consequence of which the escutcheon is much broader; it is, moreover, not so truncated on the posterior margin, which is not quite so long.

FAMILY PETRICOLIDÆ.

Venerupis paupertina, *spec. nov.* Plate xiv., fig. 15.

Shell ovate-oblong, moderately convex; anterior side short, somewhat acuminately rounded; posterior side truncated, ob-

tusely angled from the umbo to the post-ventral border; ventral and post-dorsal margins straight, almost parallel. Umbo conspicuous, incurved; lunule small, but well defined.

Surface with somewhat distant and irregularly disposed concentric lamellæ, slightly crenated and foliated, especially on the posterior slope, and rayed with rather distant flat ribs, equal in width to the interspaces. Hinge of right valve with three cardinal teeth, widely and equally separated; the anterior one short and stout, the others very prominent and simple; the ligamental lamella extends to more than half the length of the post-dorsal line. Pallial sinus small, rounded, horizontal.

Dimensions.—Length, 12; height, 7; thickness through both valves, 5 millimetres.

Localities.—Upper beds at Muddy Creek, Hamilton; and oyster beds of the River Murray Cliffs at the Nor'-West Bend.

This species has a great resemblance to *V. exotica*, Lamarck, but the umbo is larger and more cordate; the posterior margin is narrower, the post-dorsal area is more defined, and the radial ribs are flat, and not angular; internally further differences are presented by the cardinal teeth and the elongate ligamental lamella. In its flat ribs and cordate umbo, the fossil resembles *V. mitis*, Desh., but is in other respects different.

Genus Tellina.

synopsis of species.

A. Siphonal inflection confounded with the pallial line.
- Elongate, hardly compressed, posteriorly subrostrated. *T. lata.*
- Oval, compressed, posteriorly sub-angular. *T. albinelloides.*
- Oblong, posteriorly short and cuneiform. Umbo in posterior one-fourth; ventral margin nearly straight. *T. porrecta.*
- Umbo in posterior one-third; ventral margin arched; lamellate *T. Masoni.*
- Triangularly-ovate, compressed, posteriorly flexuous and obsoletely carinated *T. Cainozoica.*

B. Siphonal inflection detached from the pallial line.
- Oval-oblong, nearly equilateral; somewhat smooth. *T. equilatera.*
- Elongate oval; inequilateral; concentrically ridged. *T. Stirlingi.*

Tellina Cainozoica, *T. Woods*. Plate xviii., fig. 5.

Reference.—Proc. Roy. Soc. Tasmania for 1876, p. 113.

Ovate-oblong, equivalve, inequilateral, very compressed and thin; anterior end rounded, posterior end sub-rostrated, not inflected; posterior carina inconspicuous and very close to the margin; umbos small, obtuse, antemedian. Surface ornamented with very fine and close growth-lines, and equidistant thin, erect, inconspicuous lamellæ. Interior unknown.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 15; intersection of the diameters at 11·5 from the anterior end; sectional diameter, 5.

Locality.—Table Cape, Tasmania (*R. M. Johnston!*)

This species, uniquely represented, so closely resembles *T. alba*, Quoy and Gaimard, of the same size, actual specimens of which from the Wanganui series in New Zealand have been under observation, as to suggest the probability of its being merely an individual variation of that species. However trivial the distinctive characters are, yet should they hereafter be found constant, the claim to specific rank will be fairly well established.

It differs from *T. alba* in its more central umbo, not so acutely angular posteriorly, and by the presence of raised growth-lines.

Tellina lata, *Quoy* and *Gaimard.*

Reference.—Voy. de l'Astrolabe, t. 81, figs. 8-10, vol. 3, p. 497 (1835).

Locality.—Oyster-banks or the superior fossiliferous beds in the cliffs of Aldinga Bay.

Dimensions of the largest example.—Antero-posterior, 125; umbo-ventral, 75; sectional diameter, 28.

I have little hesitancy in referring the fossils to the living species inhabiting North Australia and the Indo-Pacific regions, despite the fact they are somewhat imperfectly preserved, and have not been compared with actual specimens.

Tellina albinelloides, *spec. nov.* Plate xvi., figs. 4*a*—4*b*.

Oval, subequilateral, very compressed, thin, pellucid, anterior side rounded, posterior side produced, subangulated, and slightly folded. Umbones inconspicuous, acute, directed backward, and situated a very little in front of the centre. The exterior is ornamented with fine, regular, concentric striæ, which are raised into thin, narrow, imbricating lamellæ on the angulated posterior slope.

Dimensions.—Antero-posterior diameter, 44; umbo-ventral diameter, 22; sectional diameter through closed valves, 5·5 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

The fossil shells are not readily separable from *T. albinella*, inhabiting Southern Australia, with which they agree in dentition and in the broad deep pallial inflection, the posterior line of which is confluent with the pallial impression. In its adult stage *T. albinelloides* is about the same size of ordinarily full-grown examples of *T. albinella*; but it is more decidedly inequivalve, the right valve being markedly depressed, especially in the posterior half, in consequence of which greater prominence is given to the small subacute umbo. The breadth is proportionately less, and therefore the front dorsal slope is less arched; the post-ventral margin does not ascend so rapidly, which with the straighter front dorsal margin impart a contour sufficiently distinctive to be of specific value. The young shells of each differ in the following particulars:—In *T. albinella* the posterior side is narrow and more rostrated, in *T. albinelloides* it is broader, abruptly arched, and shortly rostrated.

The ornament is equally variable in the fossil as in the living analogue.

Tellina porrecta, *spec. nov.* Plate xvi., fig. 8.

Transversely-elongated, very inequilateral, the anterior side three times as long as the posterior; narrowed and sharply rounded in front, cuneiform behind; moderately convex. The ventral margin is broadly rounded at the middle and front, incurved posteriorly. Surface ornamented with fine distant concentric liræ, which are more pronounced on the posterior slope. Dentition unknown.

Dimensions.—Antero-posterior diameter, 9·25; umbo-ventral diameter, 4·5; sectional diameter of one valve, one millimetre.

Locality.—Green sands, Adelaide bore.

Tellina Masoni, *spec. nov.* Plate xvi., figs. 6*a*—6*b*.

Transversely-oblong, rather convex, inequilateral, the anterior side twice as long as the posterior. Front-dorsal margin elongated, hardly oblique, slightly arched; post-dorsal margin rapidly descending, straight, and narrowly truncated at the extremity; ventral margin arched anteriorly and towards the posterior side inconspicuously incurved. The left valve is feebly concavely depressed behind the posterior carination.

The exterior surface is ornamented by closely-set, thin, very slightly elevated concentric lamellæ. There are two cardinal teeth in each valve, and well-developed laterals in the right. Pallial sinus very large, reaching to near the anterior adductor scar.

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 11; sectional diameter of both valves, 6 millimetres.

Locality.—Rare in the older beds at Muddy Creek.

It is with much pleasure I associate with the species the name of the proprietor of the land on which the chief fossiliferous deposits of Muddy Creek are found; also because of his hospitality and assistance rendered to all visitors in search of fossils.

Tellina æquilatera, *spec. nov.* Plate xvi., figs. 5*a*—5*b* and 9*a*—9*b*; plate xx., fig. 19.

Ovate-oblong, subequilateral, rather thick, smooth, and somewhat convex. Post-dorsal margin straight, a little more descending than in front, which is slightly incurved; front margin broadly rounded; posterior side narrower, abruptly and narrowly rounded at the extremity. There is a slight radial depression near the post-dorsal margin, proceeding from the umbo, which produces an inconspicuous insinuation at the posterior extremity. The umbones are small, acute, and situated a very little in front of the centre.

The exterior is ornamented with fine incised concentric lines and zones of colour. The siphonal inflection is very deep, narrow, rounded at the extremity, reaching to near the anterior adductor scar, and is quite detached from the pallial impression.

The left valve has one bifid cardinal tooth; the right valve with two cardinal teeth, the posterior one much larger and bifid; a strong lateral tooth on each side, the anterior one being nearer to the cardinal teeth.

Dimensions of a medium-sized example:—Antero-posterior diameter, 52; umbo-ventral diameter, 35; sectional diameter of left valve at three-sevenths from the umbo, 8·5 millimetres.

Locality.—Upper beds at Muddy Creek; calciferous sandstone, River Murray Cliffs, near Morgan.

Plate xx., fig. 19, represents an adult example from Muddy Creek; plate xvi., fig. 5, an averaged-size specimen, also from Muddy Creek; plate xvi., fig. 9, is a young shell from the River Murray Cliffs—the figure, however, is not correct, being too much angled posteriorly, and too much arched ventrally.

Tellina Stirlingi, *spec. nov.* Plate xvi., figs. 7*a*—7*b*.

Elongate-oval, considerably inequilateral, rather thin, subpellucid, and somewhat convex; the anterior side is half as long again as the posterior, narrowed and subacuminately rounded behind. Surface ornamented concentrically with slender, not crowded, subacute ridges, and a few broadish furrows.

There are two cardinal teeth in each valve, and well-developed laterals in the right. The siphonal sinus is large, rounded, ascending into the umbonal cavity, reaching to mid-

way between the adductor scars, and is quite free from the pallial line.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 6; sectional diameter of both valves, 3·5 millimetres.

Locality.—Not uncommon in the lower beds at Muddy Creek.

Species-name in compliment to Mr. James Stirling, F.G.S., F.L.S., who has so ably described the physiographic features of the Victorian Alps in a long series of papers communicated to several Scientific Societies.

Strigilla australis, *spec. nov.* Plate xix., fig. 6.

Oval, compressed, thin, shining, inequilateral, the posterior side being the longer; umbo small, acute. The sculpture consists of incised lines, which, as regards direction, are grouped in three distinct regions—(1) On the anterior side they are transverse, more or less coincident with the margin, becoming (2) oblique on the median portion, those nearest the front being abruptly bent, the included angle widening towards the umbones; (3) the narrow post-dorsal area is covered with numerous oblique striæ, interrupted by the posterior lines of the middle region, and making with them acute angles, directed ventrally. The umbonal region has concentric striæ only. The left valve has one bifid cardinal tooth and an approximate lateral denticle on each side.

Dimensions.—Antero-posterior diameter, 9·5; umbo-ventral diameter, 7·5 millimetres.

Locality.—Lower beds at Muddy Creek.

Psammobia Hamiltonensis, *Tate.* Plate xvi., fig. 13.

Reference.—Southern Science Record, January, 1885, p. 4.

Shell shining, compressed; transversely elliptical, attenuated anteriorly, and obliquely truncated posteriorly; sculptured with incised lines concentric with the margin, which become rugæ on the angulated posterior area.

The fossil closely resembles the living *P. zonalis*, Lk., from which it differs in being narrower, more attenuated anteriorly, and less abruptly truncated posteriorly. The post-dorsal line is not so straight, and the post-ventral margin is a little more ascending, so that the posterior margin is more attenuated and less abruptly truncated; the anterior margin is also more produced.

Dimensions.—Antero-posterior diameter, 31; umbo-ventral diameter, 15 millimetres.

Localities.—Common in the upper beds at Muddy Creek, Hamilton (*R. T.*); Table Cape (*R. M. Johnston!*)

Psammobia æqualis, *Tate.* Plate xvi., fig. 10.

Reference—Southern Science Record, January, 1885, p. 4.

Shell compressed; umbo central, depressed; transversely elliptic; attenuated anteriorly; roundly truncated posteriorly; sculptured with concentric closely arranged raised lines.

Dimensions.—Antero-posterior diameter, 22; umbo-ventral diameter, 11 millimetres.

Localities.—Upper beds at Muddy Creek; Middle Murravian series near Morgan, on the River Murray (*R. T.*); Table Cape (*R. M. Johnston!*).

This species differs from *P. Hamiltonensis* by the absence of a posterior keel. Its representative in living creation is the British *P. tellinella*, Lk., from which it differs by its central and depressed umbo, compressed valves, more attenuated anterior margin, and rounded posterior margin.

Donax Dixoni, *spec. nov.* Plate xvi., fig. 15.

Triangularly ovate, subequilateral, the posterior side being a little longer, flatly convex; posterior margin obliquely truncated, anterior side acuminately rounded. Umbones a little oblique, small, situated a little in front of the centre.

Surface ornamented by broad flatly rounded radial ribs, which are wrinkled by concentric striæ and grooves; on the posterior slope the costæ are not much wider than the intervening sulci; but on the post-medial area the sulci are linear; the radial costæ become obsolete on the anterior side.

Ventral margin of the valves coarsely crenulated.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 6·5; sectional diameter of one valve, at about the middle, 2 millimetres.

Locality.—Lower beds at Muddy Creek.

Species-name in compliment to Mr. Samuel Dixon, my companion on many geological excursions.

The species has much resemblance to *D. cardioides*, Lamarck, but is not abruptly inflated medially.

Donax depressa, *spec. nov.* Plate xvi., fig. 11.

Broadly triangularly ovate, very inequilateral, rather depressed, but abruptly and sharply elevated from the umbo to the post-ventral angle; posterior side depressed and roundly truncated at the extremity; anterior extremity sub-acuminately rounded. The ventral margin is nearly straight, but is inconspicuously incurved in front of the keel.

The surface of the anterior portion is almost smooth, finely radially and distantly concentrically grooved; granulately wrinkled on the keel; radially and concentrically finely ridged on the depressed, flat posterior area.

Margin of the valves plain.

Dimensions.—Antero-posterior diameter, 37; umbo-ventral diameter, 25; sectional diameter of one valve, 6 millimetres.

Locality.—Oyster beds at Nor.'-West Bend, River Murray.

FAMILY SEMELIDÆ.

Semele vesiculosa, *spec. nov.* Plate xvi., fig. 12.

Transversely ovate, inequilateral, somewhat inflated. The anterior side is the longer and rounded, the posterior side is obtuse angled; slightly inequivalve, the right valve not so convex as the other, and less inconspicuously angled at the umbonal slope; umbones acute, approximate, situated a little behind the centre; front dorsal margin slightly incurved in front of the beaks; post-dorsal margin slightly arched, with a considerable descending slope; ventral margin broadly arched at the front and middle, slightly insinuated posteriorly. Lunule broadly lanceolate, hardly impressed.

Exterior surface, glossy, white, with a few growth lines.

Left valve with one cardinal tooth in front of and rather distant from the short narrow oblique cartilage pit, sometimes with a small short lamina arising from the distal end of the cardinal tooth and directed backwards. Right valve with two divergent cardinal teeth in front of the cartilage pit. There is a well-developed lateral on each side. The pallial sinus is wide, broadly rounded at the apex, and extending for two-thirds across the interior.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 6; sectional diameter of both valves, 5 millimetres.

Locality.—Not rare in the lower beds at Muddy Creek.

Var., with longer posterior side and more pointed extremity common in the calciferous sandstones of the River Murray Cliffs near Morgan.

Semele Krauseana, *spec. nov.* Plate xvi., figs. 18*a*—18*b*.

Transversely-oval, inequilateral, thin, moderately convex; the valves a little unequal, both are turned conspicuously to the right at the hinder end, and there slightly gaping. The anterior side is the longer and rounded, the posterior subrostrated, with a slight fold continued from the umbo to the post-ventral margin. The umbones are very small, acute, contiguous, situated at four-sevenths of the whole length from the front; lunule lanceolate concave. The dorsal margins are straight, the hinder more rapidly sloping than the front; the ventral margin is broadly arched anteriorly, slightly incurved, and rapidly ascending posteriorly. The exterior surface is shining, white, with one or two zones of colour; concentrically finely striated.

Dimensions.—Antero-posterior diameter, 21 ; umbo-ventral diameter, 12 ; sectional diameter of closed valves, 7 millimetres.

Localities.—Clays at Schnapper Point, Port Phillip ; lower beds at Muddy Creek ; calciferous sandstone of the River Murray Cliffs near Morgan.

Professor McCoy, in Report Geol. Surv., Victoria, No. 2, figures on p. 22, under the name of *Tellina Krausei*, the impression of a Tellina-like shell obtained near Stawell, and states that the species is common in the Tertiary beds at Schnapper Point. It may possibly be *Semele Krauseana*, with which it agrees in shape, but doubtfully so, as the drawing indicates an ornamentation of thick concentric ridges, unless, however, it be faulty in this particular. The figure is unaccompanied by description.

The species-name is in compliment to Mr. F. M. Krausé, F.G.S., Lecturer on Geology at the Ballarat School of Mines, and late of the Geological Survey of Victoria.

FAMILY MACTRIDÆ.

Genus Mactra.

SYNOPSIS OF THE SPECIES.

Broadly ovately-trigonal; subacuminately produced posteriorly ; wavy wrinkled at the sides. *M. axiniformis.*

Shorter and broader ; posterior side straight ; concentric striæ simple at the sides. *M. Hamiltonensis.*

Elongate-ovate, attenuated at the extremities. *M. Howchiniana.*

Mactra axiniformis, *spec. nov.* Plate xvii., figs. 1*a*—1*b*.

Ovately trigonal; thickish, rather tumid, inequilateral, bluntly rounded in front, the posterior side the longer and sub-acuminately produced. Ventral margin broadly arched, inconspicuously insinuated towards the posterior extremity; dorsal margins about equally sloping, the front a little arched, the posterior one longer, at first slightly ecurved, thence straight. The surface is shining, brown with zones of lighter colour ; almost smooth in the medio-dorsal region ; the rest of the valve ornamented with concentric slender growth-ridges and striæ ; the ridges are fewer, thicker, and wrinkled on the anterior angulation, those on the posterior carination are obliquely striated.

The pallial line is very broad and near the margin, the siphonal inflection is horizontal, rounded at the end, and extends to a little more than one-fourth the distance between the adductor scars.

Dimensions.—Antero-posterior diameter, 42; umbo-ventral diameter, 29·5; sectional diameter of united valves, 20 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

This species has the aspect of *M. rufescens*, Lamarck, a well-known shell inhabiting the temperate regions of Australia, from which it differs by being more attenuated in front and behind, proportionately longer, and having finer ornament.

Mactra Hamiltonensis, *spec. nov.* Plate xvii., figs. 4*a*—4*b*.

Ovately elongate, subequilateral, slightly convex, thin, shining. The anterior side is rather shorter than the posterior, the former is broader and obtusely rounded at the end, the latter is narrowed towards the end, where it is sharply rounded.

The ornament consists of thin elevated growth lines, which are here and there confluent one with another.

The pallial sinus is sharply rounded at the end, and reaches a third of the length across the valves.

Dimensions.—Antero-posterior diameter, 23; umbo-ventral diameter, 18; sectional diameter of united valves, 9 millimetres.

Locality.—Common in the upper beds at Muddy Creek.

This species is the analogue of the living *M. polita*, Chemnitz, of Southern Australia, from which it differs by its flatter valves and less triangular outline, being proportionately longer and the ventral margin not so broadly curved.

Mactra Howchiniana, *spec. nov.* Plate xvii., figs. 3*a*—3*b*.

Oblong, attenuated at both extremities, inequilateral, thin, shining. The anterior side is shorter and narrower than the posterior, the front-dorsal margin is slightly concave, the post-dorsal slightly arched; the ventral margin is almost straight medially, but ascends more rapidly behind than in front.

The surface is concentrically finely ridged and striated.

The lateral teeth are transversely wrinkled on the dorsal face. The pallial sinus is rather broad, rounded at the apex, confounded with the pallial line, and extends about half-way across the valve.

Dimensions.—Antero-posterior diameter, 41; umbo-ventral diameter, 23; sectional diameter of both valves, 12 millimetres.

Locality.—Rare in the lower beds at Muddy Creek. Young shells not uncommon in the calciferous sand-rock of the River Murray Cliffs, near Morgan; rare in the clays at Schnapper Point, Hobson Bay.

The specific name is in compliment to Mr. Walter Howchin, F.G.S., who has elaborated for the author the Foraminifera of the Older Tertiary beds of Australia.

Zenatiopsis angustata, *Tate.*

Reference.—Trans. Roy. Soc., S. Aust., 1879, p. 129, t. 5, fig. 6.

Externally like the living *Zenatia acinaces*, Quoy and Gaimard, but is narrower, more attenuated posteriorly, and the anterior side is longer and not so abruptly arched; internally it differs by the presence of a thick rib descending vertically from the umbo.

Localities.—Gastropod-bed of the River Murray Cliffs near Morgan; upper and lower beds at Muddy Creek; Table Cape (*Hobart Mus.!*)

FAMILY PAPHIIDÆ.

Anapa variabilis, *spec. nov.* Plate xvii., figs. 5*a*—5*b*.

Ovately-trigonal, rather thin, inequilateral; umbones inflated, antemedian; posterior side the longer, bluntly rounded at the extremity; the anterior end is rounded, and the front-dorsal slope slightly incurved. The surface is ornamented with moderately fine growth ridges and striæ.

Dimensions.—Antero-posterior diameter, 17·5; umbo-ventral diameter, 13·5; sectional diameter of united valves, 11 millimetres.

Locality.—Common in the oyster banks of Blanche Point Cliff, Aldinga Bay.

The figured example fairly represents the mean of extremes of form assumed by this species, which is closely related to *A. cuneata* and *A. triquetra*; from which it differs by its greater gibbosity, rounded posterior extremity, and the convex not flattened posterior slope. Some very young examples are triquetrous, and with difficulty separable from *A. triquetra* at the same stage of growth.

FAMILY ANATINIDÆ.

Thracia perscabrosa, *spec. nov.* Plate xv., fig. 5.

Right valve moderately convex, ovately-oblong, narrowed in front and broadly truncated behind; umbones post-median; posterior area concavely depressed, separated from the rest of the valve by a rounded carination extending from the umbo to the post-ventral angle. The post-dorsal margin is nearly straight, nearly parallel with the ventral margin; the front dorsal margin is somewhat ecurved and oblique. The anterior end is rather wedge-shaped, and rounded at the extremity; the posterior end is abruptly truncated, forming a rounded angle with the ventral margin, and an obtuse angle (about 105 deg.) with the dorsal margin; the ventral margin is very little curved, ascending in front.

The posterior area is coarsely granulated, the rest of the surface less so; conspicuous folds of growth occur at irregular intervals.

Dimensions.—Antero-posterior diameter, 33; umbo-ventral diameter, 21; sectional diameter of right valve, 7 millimetres.

Localities.—Muddy Creek (lower beds)—a right valve only; Adelaide bore, a left valve, probably of the same species.

Among recent species this fossil shell is much like *T. speciosa*, Angas, but is less inequilateral, and more attenuated at the front.

Genus Myodora.

synopsis of the species.

A. Elongate, subinequivalve.
  Anterior side five times as long as the posterior; broadish. *M. prælonga.*
  Anterior not much longer than the posterior; very narrow. *M. angustior.*

B. Right valve convex; left valve flat.
  Right valve oblong; finely concentrically ridged, radially striated. *M. tenuilirata.*
  Right valve ovately-oblong, with numerous close concentric ridges. *M. australis.*
  Right valve ovate, with few distant concentric ridges. *M. corrugata.*
  Right valve triangularly ovate, somewhat acuminate anteriorly; left valve truncated posteriorly. *M. lamellata.*
  ? ? ; left valve equilaterally trigonal. *M. æquilateralis.*

Myodora prælonga, *spec. nov.* Plate xix., figs. 12*a*—12*d*.

Elongately-oblong, thickish, inequivalve, very inequilateral, the anterior side being about five-sixths the total length, anteriorly rounded and posteriorly vertically truncated. The front dorsal slope is slightly convex, the post-dorsal margin incurved behind the umbo, ventral margin almost straight, and horizontal; the post-dorsal slope is bluntly angulated.

The surface of the valves is smooth, with concentric growth lines.

The pallial sinus is broad, rounded at the end, and extends to nearly half the length of the shell.

The right valve is moderately convex, the other is depressed, almost flat.

Dimensions.—Antero-posterior diameter, 14; umbo-ventral diameter, 7·5; sectional diameter of right valve, 2·25 millimetres.

Locality.—Upper beds at Muddy Creek.

This Thracia-like species is very similar to and has the same interior characters as *Alicia angustata*, Angas, but is more robust and broader.

Myodora angustior, *spec. nov.* Plate xvi., fig. 16.

This species is related to the last, but is less inequilateral, and is much narrower than the allied species *M. angustata;* the concentric ridges are more pronounced, and the post-umbonal angulation is almost obsolete. The pallial sinus, which is strap-shaped, extends across to the anterior adductor scar as in *Alicia elegantula*, Angas; but the shape of that species is very different.

Dimensions.—Antero-posterior diameter, 10; umbo-ventral diameter, 4·5 millimetres.

Locality.—Upper beds at Muddy Creek.

Myodora tenuilirata, *spec. nov* Plate xvii., figs. 9*a*—9*b*.

Transversely elongate-oblong, thin, inequilateral, somewhat acuminately rounded in front, abruptly truncated behind. Right valve moderately convex; post-dorsal margin nearly straight, much longer than the front-dorsal margin, which makes with it an angle of about 150 deg.; posterior margin vertically truncated; ventral margin very gently curved, except towards the anterior, where it rapidly ascends. Conspicuously carinated from the umbo to the post-ventral angle. Surface ornamented with close-set, fine, concentric ridges, crossed by radial wavy microscopic thread-like lines. Left valve flat, a little concave in the umbonal region, with a few concentric lines, but the radiating minute threads more conspicuous and crowded than on the other valve.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 10; sectional diameter of both valves, 3 millimetres.

Localities.—Victoria: lower beds at Muddy Creek; Corio Bay; Schnapper Point. S. Australia: Turitella grits at Ardrossan; oyster beds of the River Murray Cliffs at Nor'-West Bend; gastropod beds near Morgan.

Among living species *M. tenuilirata* has a general resemblance to *M. pandoræformis*, Stutchbury, but it differs from it by being less convex, more produced posteriorly, its post-dorsal margin straighter, its ventral margin less arched, and by its more numerous concentric ribs. The fossil congener, *M. australis*, is easily separable from it by its shape.

Myodora australis, *Johnston.* Plate xvii., figs. 10*a*—10*b*.

Reference.—Proc. Roy. Soc., Tasm., for 1879, p. 40.

Ovately-oblong, inequilateral, thick, anterior side the

shorter, with a rounded extremity, posterior side abruptly truncated at the end. Right valve moderately convex, faintly ridged from the umbo to the post-ventral angle; concentrically ridged, the ridges about equidistant, and as broad as the concave interspaces, about ten in the space of five millimetres from the medial ventral margin.

Left valve flat or slightly convex, inconspicuously concavely depressed in the post-dorsal region, ornamented with concentric striæ, and radiating microscopic thread-like lines.

Dimensions.—Antero-posterior diameter, 17; umbo-ventral diameter, 13; sectional diameter of both valves, 5·5 millimetres.

Localities.—Table Cape (*R. M. Johnston !*); lower beds at Muddy Creek.

This species has more affinities with *M. ovata*, Reeve, than any other living, but it is more oblong with more numerous and closer concentric ridges on the convex valve, whilst the flat valve is concentrically striated and not plicated.

Myodora corrugata, *spec. nov.* Plate xvii., figs. 11*a*—11*b*.

Ovate, somewhat triangular, thick; ornamented with few, subdistant, thick, rounded, concentric ridges. It is extremely like *M. ovata*, Reeve, but has fewer concentric ridges.

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 14·5; sectional diameter, 4 millimetres.

Localities.—Not uncommon in the upper beds at Muddy Creek; oyster banks, Government House quarry, at Adelaide.

Myodora lamellata, *spec. nov.* Plate xvii., figs. 6*a*—6*c* and 7.

Trigonally-ovate, rather solid, subequilateral, anteriorly rather acuminate; posterior margin scarcely truncated to somewhat acuminately produced and sinuated. Right valve very convex, depressed down the posterior side; the dorsal margins about equally sloping and slightly incurved, the anterior rather more arcuated; ventral margin moderately arched, abruptly curving upwards anteriorly. Ornamented with thickish, regular, somewhat elevated concentric ridges, with broader interspaces.

Left valve flat, with finer sculpture.

Dimensions.—Antero-posterior diameter, 9; umbo-ventral diameter, 8; sectional diameter, 4 millimetres.

Localities.—Clayey green sands, Adelaide bore; and Turritella clays, Blanche Point, Aldinga Bay.

In its somewhat rounded form and very convex right valve, *M. lamellata* is related to *M. convexa*, Angas, inhabiting New Caledonia; but apart from differences in outline, the fossil

species is distinguished by the coarser and more distant liration.

Myodora æquilateralis, *Johnston*. Plate xvii., fig. 8.

Reference.—Proc. Roy. Soc., Tasmania, for 1879, p. 40.

Left valve solid, trigonal, equilateral, flat, or slightly concave; dorsal margins equally sloping, inclined to one another at an angle of 90 deg.; the front-dorsal margin straightish, or slightly arched; the post-dorsal margin straight, or slightly incurved behind the umbo; ventral margin roundly arched. Right valve unknown.

Surface ornamented with close, fine concentric ridges of growth and striæ and microscopic granules, the former forming nodulose denticulations on the front-dorsal edge.

Dimensions.—Antero-posterior diameter, 25; umbo-ventral diameter, 21 millimetres.

Localities.—Table Cape (*R. M. Johnston!*); Schnapper Point, Hobson Bay (*R.T.*); upper beds at Muddy Creek (*J. Dennant!*).

FAMILY CORBULIDÆ.

Corbula ephamilla, *Tate*. Plate xvii., figs. 13*a*—13*b*, and 14.

Reference.—Proc. Roy. Soc., Tasmania, for 1884, p. 229.

Shell solid, very inequivalve, inequilateral, ovately-triangular, rounded anteriorly, beaked posteriorly. Right valve with more than twenty very thick, rounded prominent concentric ridges, the whole surface striated concentrically. The ventral margin is outward-curved medially, and the ridges have a corresponding flexure. The posterior margin is obliquely truncated, carinated from the umbo to the post-ventral margin; posterior to the carina is a somewhat concave area on which the concentric folds are continued as multiplied lamellæ. The umbo is in the anterior third, flat, incurved, and with small ridges. Left valve ovately triangular, nearly flat, pointed behind, carinated from the umbo to the post-ventral margin; surface irregularly striated by lines of growth; umbo flattish, from below which two distinct ridges radiate to the ventral margin, one or two additional but shorter ones sometimes occur. Young shells distantly radially striated, the striæ more prominent and closer on the posterior slope. Right valve with an anterior pointed tooth; left valve with a stout posterior tooth, flattened and sulcated on its upper surface. Pallial sinus indistinct.

Dimensions.—Antero-posterior diameter, 21; umbo-ventral diameter, 16; sectional diameter of united valves, 10 millimetres.

Localities. — Tasmania: Table Cape (*R. M. Johnston!*).

South Australia: Oyster beds at Nor'-West Bend; very abundant in the calciferous sand-rock of the River Murray Cliffs, near Morgan; in a well-sinking at "Nine-Mile Camp," near Nor'-West Bend. Victoria: Upper and lower beds at Muddy Creek; Corio Bay; Schnapper Point.

From the living *C. sulcata*, Lamarck, to which it has been referred, our fossil species differs in being less inequilateral, more pointed posteriorly, less gibbous, &c. A nearer ally among existing species is *C. fortisulcata*, E. Smith, from which it differs particularly in its truncated posterior margin.

Corbula pixidata, *spec. nov.* Plate xvii., figs. 12*a*—12*b*.

Ovately rhomboidal, rather solid, inequilateral, subinequivalve, moderately convex; the posterior side is a little produced, obliquely truncated, and sharply carinated from the umbo to the post-ventral angle. The umbones are in the anterior third, rather inflated, depressed, and incurved. The left valve is a little smaller than, and included within, the suberect ventral and posterior margins of the right valve; both are equally convex.

Both valves have the same ornamentation, which consists of angular concentric ridges and radial striæ; the ridges are usually numerous, fine, and close together, but are sometimes thicker and fewer.

Dimensions of a large specimen.—Antero-posterior diameter, 10·5; umbo-ventral diameter, 6·5; sectional diameter through both valves, 5 millimetres.

Localities. — Common in the Turritella clays at Blanche Point, Aldinga, and corresponding beds in the Adelaide bore.

C. pixidata is much like the young of the last species, but it is less inequivalve, more convex, with larger umbones, and is proportionately shorter.

Neæra subrostrata, *spec. nov.* Plate xv., figs. 2*a*—2*b*.

Ovate, inequilateral, produced into a long beak behind, moderately convex, thin; front dorsal margin slightly convex and considerably sloping, the post-dorsal part somewhat longer, less oblique, and moderately concave; the ventral margin is irregularly arched, sinuated in front of the rostral prolongation. A distinct keel starts from behind the umbo, is directed towards but does not extend so far as the lower corner of the rostrum.

The ornament consists of coarse concentric lines of growth, becoming lamellose at the umbo and rostral insinuation.

Right valve with an elongate lateral tooth on the posterior side; left valve edentulous; cartilage-plate well developed, obliquely inclined backward.

Dimensions.—Antero-posterior diameter, 18; umbo-ventral diameter, 9; sectional diameter of one valve, 3·5 millimetres.

Locality.—Lower beds at Muddy Creek.

This species is similar to *N. rostrata*, Spengler, and *N. Angasi*, E. A. Smith, but it has a shorter anterior side.

Young? fig. 2*b*, which seems indistinguishable from *N. inflata*, Jeffreys, P.Z.S., 1881, t. 71, f. 8, has the following dimensions: —Antero-posterior diameter, 6·5; umbo-ventral diameter, 4·5 millimetres.

Neæra Adelaidensis, *spec. nov.* Plate xix., fig. 8.

Ovate, rather depressed, inequilateral, anterior end rounded, posteriorly produced into a longish slender beak; the beak is obliquely bisected by a sharp radiating ridge.

The surface is ornamented by few, regular, distant, short, and thin lamellæ. Interior unknown.

Dimensions.—Antero-posterior diameter, 5; umbo-ventral diameter, 3; sectional diameter of closed valves, 1·5 millimetres.

Locality.—Adelaide bore.

Neæra (Rhinomya) latesulcata, *spec. nov.* Plate xix., fig. 7.

Broadly-triangular, inequilateral, thin, flat, rounded anteriorly, produced and subrostrated posteriorly; ventral margin very slightly arched medially, inconspicuously insinuated posteriorly, somewhat rapidly ascending anteriorly; post-dorsal margin straight, much longer than the slightly arched front-dorsal margin; the posterior margin is very narrow, straight, and forming an obtuse angle with the ventral margin. The umbonal region is finely concentrically striated, and surmounted by a smooth umbonal papilla; the rest of the surface ornamented with six acute concentric folds, raised into thin, short, erect lamellæ; the broad interspaces finely concentrically striated. The post-dorsal area is defined by a raised line proceeding from the post-ventral angle towards the umbo as far as the smooth umbonal area. The right valve has a short anterior tooth, and an elongate lamellar tooth posteriorly for about one-third the distance from the umbo, beyond which it is continued as a shelf-like process to the extremity of the post-dorsal margin. There is no cartilage-process.

Dimensions.—Antero-posterior diameter, 4; umbo-ventral diameter, 2·5 millimetres.

Locality.—Adelaide bore.

FAMILY SAXICAVIDÆ.

Saxicava arctica, *Linn.*

Synonym.—*Saxicava australis* (Lamk.), Tate in Trans. Roy. Soc., S. Aust., for 1885, pl. xii., fig. 8.

A few specimens of Saxicava obtained from the basal beds of the marine series of the Older Tertiary, passed through in the Adelaide bore, fall within the limits of variation of the above-named protean shell of world-wide distribution. Also ranging from Miocene to Recent, in New Zealand.

Panopæa Agnewi, *T. Woods.*

Reference. — *Lyonsia Agnewi*, Tenison-Woods, Roy. Soc., Tasm., for 1875, f. 13, p. 25.

Transversely-ovate, inequilateral, somewhat solid, convex, concentrically ridged and striated, posteriorly attenuately rounded, anteriorly obliquely produced, and broader; gaping at both ends. Test minutely granulated in the umbonal regions, intricately radially striated on the posterior side towards the margin.

Dimensions of the type specimen.—Antero-posterior diameter, 77; umbo-ventral diameter, 44; length of anterior side, 27; length of posterior side, 50; sectional diameter through both valves, 32 millimetres.

Locality.—Table Cape (*Hobart Mus.!* and *R. M. Johnston!*)

Panopæa orbita, *Hutton.* Plate xviii., fig. 3.

Reference—Quart. Journ. Geol. Soc., vol. 41, p. 451, 1885.

Synonym.—*P. plicata*, Hutton, Cat. Foss., N. Zealand, p. 17, 1873 (non Sowerby).

The specific identity of the Australian and New Zealand specimens associated under the above name rests on the comparisons of actual examples. *P. orbita* is closely related to *P. Agnewi*, but the latter is more inflated, and of different dimensions.

Dimensions of the figured example. — Antero-posterior diameter, 85; umbo-ventral diameter, 37; length of anterior side, 25; length of posterior side, 60; sectional diameter through both valves, 26 millimetres.

Localities.—Oyster beds at Aldinga and Adelaide (casts), Middle Murravian series near Morgan, and the correlated beds at Muddy Creek. Also in the Pareora Series, New Zealand.

Capistrocardia, *nov. gen.*

Etymology—*Capistrum*, a halter, and *cardo*, a hinge. Type—*C. fragilis*, spec. nov.

Shell transverse, equivalve, inequilateral, closed at both ends; ligament external; a cardinal tooth in each valve, and an umbonal rib extending across the interior; pallial sinus entire, discontinuous.

The hinge line is very short and narrow. The right valve has a broadish erect tooth contiguous with the umbo, posterior to which is a shallow pit, bounded above by a linear ridge,

which supported the external ligament; in the left valve the cardinal tooth is obliquely transverse, and the posterior pit is broad; there is a short ligamental ridge, as in the right valve. The umbonal rib, which is confluent with the cardinal tooth, is short, and extends vertically across the interior to near the ventral margin. The anterior adductor impression is almost margined in front of the umbonal rib; the posterior adductor impression is a little nearer the posterior end than to the umbo. The pallial line is broken up into large spots, and there is no sinus (at least none is observable in the two examples, in which the pallial spots are clearly traceable).

This genus has an external resemblance to Saxicava, whilst its dentition agrees with Panopæa; from both of which it differs by its closed valves and internal septa. The discontinuous pallial line is a character belonging to Saxicava, and to some species of Panopæa, but in both those genera it is sinuated.

Capistrocardia fragilis, *spec. nov.* Plate xix., figs. 14*a*—14*b*.

Shell small, thin, translucent, transversely elongate-oblong. Umbones depressed, approximate, near to the anterior margin. Anterior margin rounded; dorsal margin sloping backwards, forming an obtuse angle with the posterior margin, which is straight or slightly convex outwardly; ventral margin straight, save for a broadish post-medial inflexion. The umbonal ridge, extending to the post-ventral margin, is moderately raised and roundly angulate.

The exterior surface of the valves is smooth and concentrically distantly striate; a few lamellæ appear towards the margins.

Dimensions.—Antero-posterior diameter, 11·5; umbo-ventral diameter, 5 millimetres.

Locality.—Gastropod bed of the middle Murravian, near Morgan. Ten examples (*R.T.*).

FAMILY SOLENIDÆ.

Solen sordidus, *spec. nov.* Plate xix., fig. 2.

This species is so very like *S. Sloanii*, inhabiting the coast of New South Wales, that a detailed description is unnecessary. It differs by its straighter dorsal line and being a little narrower; in *S. Sloanii* the length is five and a-half times the width; in *S. sordidus* it is six times. The actual dimensions are—Length, 42·5; breadth, 7 millimetres.

Locality.—Muddy Creek.

The species has the dentition of *Solen* and not of *Ensis*.

Genus Solecurtus.

synopsis of the species.

Roundly truncated anteriorly.
- Posterior side broader; grooves on the umbonal slope angularly turned back. *S. Legrandi.*
- Posterior side narrower, grooves hardly curved on the umbonal slope. *S. Dennanti.*

Acutely rounded anteriorly, grooves roundly curved on the umbonal slope. *S. ellipticus.*

Solecurtus Legrandi, *spec. nov.* Plate xvii., fig. 15.

Transversely-oblong, thickish, gaping at both ends, slightly convex, but medially and antero-dorsally depressed; inequilateral, the posterior side about three-fifths the whole length, anterior side narrower than the posterior. Front-dorsal line straight, perceptibly sloping, and slightly incurved, post-dorsal margin rather abruptly ecurved; ventral margin horizontal, curving upwards more abruptly at the front than behind; anterior margin roundly truncated. Umbones small, approximate, recurved, hardly projecting beyond the dorsal margin.

Surface shining, white, blotched with brown about the middle and posterior regions; ornamented with distant linear concentric grooves and striæ; radially finely striated on the anterior slope. The sculpture consists of engraved lines *en chevron*, radiating from the umbo to the posterior and ventral margins, not extending on to the area limited by a line drawn from the umbo to front ventral angle; the anterior limb of each sculpture line is arched—the convexity towards the front dorsal side, and its continuity interrupted by the concentric grooves; the posterior limb is straight, with a wavy outline.

Dimensions.—Antero-posterior diameter, 40; umbo-ventral diameter, 17·5; sectional diameter, 10 millimetres.

Locality.—Table Cape (*Hobart Mus.!*).

By the courtesy of the Council of the Royal Society of Tasmania, I have had under examination the unique type of *Solecurtus Legrandi*, T. Woods, Proc. Roy. Soc., Tasm., for 1875, p. 25, pl. 3, f. 14; but as the figure incorrectly represents the shell with abruptly truncated extremities, which is otherwise imperfect, and the diagnosis accords therewith, I have deemed it advisable to refigure and redescribe the fossil. As it would lead to confusion to retain the Rev. J. E. Tenison-Woods' authority for the species, it appears here under the original name as a new species.

Solecurtus Dennanti, *spec. nov.* Plate xvi., fig. 17.

Transversely-oblong, moderately thick, gaping at both ends; posterior side about two-thirds the whole length; moderately

convex, medially depressed. Anterior and posterior extremities about equally rounded; ventral and dorsal margins nearly parallel; front dorsal margin a little incurved; post-dorsal margin nearly straight, gently sloping, perceptibly attenuated towards the extremity. Umbo small, acute, recurved.

Pallial sinus broad, truncately rounded at the end, almost reaching to the anterior adductor scar.

Surface shining; sculpture consisting of concentric growth-lines and fine striæ, radial striæ on the anterior and posterior slopes, and of oblique distant engraved lines posterior to a line joining the umbo and the antero-ventral margin. The oblique lines of sculpture are nearly straight on the medial portion of the valve, crossing on to the post-dorsal slope in a gentle curve.

Dimensions—Antero-posterior diameter, 29·5; umbo-ventral diameter, 12·5 millimetres.

Locality.—Lower beds at Muddy Creek (*J. Dennant!*)

Solecurtus Dennanti differs from the foregoing species in being more rounded anteriorly, more attenuated posteriorly, less inequilateral, narrower, and in the fewer and simpler oblique lines of sculpture.

Solecurtus ellipticus, *spec. nov.* Plate xvi., fig. 14.

Transversely ovate-oblong, thin, translucent, inequilateral, posterior side about five-eights of the whole length; somewhat attenuated at both ends, obliquely rounded in front, broadly rounded behind; the dorsal margins straight, the front part sloping more rapidly than the other.

The oblique lines of sculpture are distant, a little curved on the medial portion of the valve, roundly turned back as they cross on the dorsal slope.

Dimensions.—Antero-posterior diameter, 16; umbo-ventral diameter, 8 millimetres.

Locality.—Gastropod-bed in the River Murray Cliffs, near Morgan.

This species differs from the two former by its sloping dorsal margins; in the arrangement of its sculpture-lines it approximates to *S. Dennanti*, of which it may possibly be a young example. Compared with *S. candidus*, it is distinguished by its sloping dorsal margins, and therefore more attenuated extremities; the umbonal ridge is obsolete, and consequently the sculpture-lines are curvilinear and not angulated, they are, moreover, wider apart.

FAMILY PHOLADIDÆ.

Barnea tiara, *spec. nov.* Plate xviii., figs. 1*a*—1*c*.

Narrowly-elongate, inequilateral, the umbo situated at three-sevenths of the whole length from the front, attenuated at both

ends, acutely rounded in front, bluntly rounded behind. The post-dorsal area is very precipitous and concave behind the umbo. The surface is ornamented with concentric liræ, which are angular on the medial and anterior areas, and there crossed by radiating threads, which are subspinose at the intersections, the insterstitial spaces are concentrically striated; on the posterior half of the valve the concentric liræ are rounded, sharply bent forward on crossing the umbonal ridge, and the surface is granulated.

The single *dorsal plate* is narrowly oblong, rounded at the front, the very short posterior side is bent down at right angles, roundly truncated and medially insinuated at the end. The anterior portion of the plate has a wide, shallow median depression, bounded by an obtuse ridge on each radiating from the umbo, the whole crossed by closely-set sharply-arched lamellæ; the narrow lanceolate depressed marginal areas exterior to the umbonal ridges are granulated.

Dimensions.—Antero-posterior diameter, 42; umbo-ventral diameter, 12; sectional diameter of one valve, 6 millimetres.

Locality.—Upper beds at Muddy Creek.

Jouannetia cuneata, *spec. nov.* Plate xvii., fig. 2.

Subglobose, inequilateral; posterior side somewhat depressed, cuneiform, its extremity bluntly rounded (not at all pointed); the anterior side is inflated, and its extremity is rounded. The shell is inequivalve by reason of the callous development from the one valve overlapping the anterior portion of the other.

An angular depression radiates from the middle of the umbo with a slight posterior inclination to the ventral margin.

The whole surface of the valve is ornamented with thin, distant concentric lamellæ, striated in the interspaces, and distant radial threads on the umbonal area of the anterior side, and a few riblets towards the anterior margin and on the post-umbonal ridge.

Dimensions.—Antero-posterior diameter, 24; umbo-ventral diameter, 17; sectional diameter of both valves, 16 millimetres.

Locality.—Glauconitic sand bed in the Adelaide bore.

The species is distinguished by its blunt posterior extremity and the fewness of the lamellæ of growth.

FAMILY TEREDINIDÆ.

Teredo (Kuphus) Heaphyi, *Zittel.*

Reference.—*Teredo Heaphyi*, Zittel, Pal. von Neu-Seeland, p. 45. tab. 14, fig. 4.

Synonym—Cladopoda directa, Hutton, Trans. N.Z. Inst., 1877, p. 597, t. 16, f. 13.

Tube elongate, round, irregularly contorted; constricted at intervals at the proximal end, more regularly distally; concamerated and closed by an outwardly convex plate.

It would seem to have attained to gigantic dimensions, as one fragment of a length of 160 millimetres has a diameter at the ends of 8 and 10 millimetres; other fragments measure 17 millimetres in diameter.

Localities.—Calciferous sand rock of the River Murray Cliffs at McBean's Pound, near Blanchetown; in the raggy limestones at Mannum; in the limestone with glauconitic grains, Aldinga Cliffs.

Teredo, *sp.*

Casts of short clavate tubes, about 15 millimetres long by three in diameter, in fossil wood at Gawler, indicate a species with a totally different habitat from the above.

Teredo, *sp.* Plate xix., fig. 4.

A single valve from the lower beds at Muddy Creek.

FAMILY GASTROCHÆNIDÆ.

Aspergillum (Humphreyia) liratum, *spec. nov.* Plate xix., fig. 11.

Disk roundly oblong, adherent by one valve. Tube cylindrical, a little irregular, slightly angulated on the dorsal and ventral sides; ornamented with longitudinal distant threads (about 20) and irregular folds of growth and striæ.

Dimensions.—Total length, 16; diameter of tube, 5 millimetres.

Localities.—A perfect example, Adelaide bore; fragments in the calciferous sandstone near Morgan, and correlated beds at Muddy Creek.

More nearly related to *A. multangulare*, Tate, than to the other two living species, but is distinguished by the numerous longitudinal threads on the tube.

One or two other species of Aspergillum are indicated by casts obtained from the glauconitic limestone at Aldinga, and corresponding bed at Witton Bluff.

APPENDIX.

Ostrea manubriata, *spec nov.* Plate xix., fig. 10.

Shell rather thick, varying from narrow oblong to elongate-acuminate. Upper valve flat or sub-concave, with thin, distant, adpressed lamellæ of growth. Attached valve narrowly compressed, abruptly convex, concentrically flexuosely ridged and

striated; hinge usually very elongate, broadly excavated in the middle.

Locality.—Common in ths upper beds at Muddy Creek (*J. Dennant !*)

This new species has considerable affinities with *O. undata* Lamk., of the Tertiary beds of Europe, but has a narrower and deeper lower valve, which is devoid of radial plications; it is also something like the recent *O. Virginica* of the same author. It is very different from any known species inhabiting the Australian seas.

Pecten deformis, *spec. nov.* Plate xviii., fig. 4.

Triangularly ovate, compressed, obliquely extended posteriorly and inequilateral; in the young state regular, subequilateral.

The young regular stage of growth is seen for about 30 millimetres from the umbo; is ornamented with about 50 radial subacute narrow ribs, usually grouped in threes, the middle one being the larger, and with quincuncially arranged depressions between the ribs.

The older stage of growth is marked by the sudden irregularity of general growth and change of ornament—the radial ridges becoming almost obsolete, and strong growth folds and concentric striæ developed.

The ears are unequal, the proximal portions radially ribbed and shagreen sculptured, the distal portions irregular and inornate.

Dimensions.—Umbo-ventral and antero-posterior diameters, 47 millimetres.

Locality.—Upper beds at Muddy Creek.

This species, which is related to *P. consobrinus*, Tate, may prove to belong to *Hinnites*, but at present the left valves only have been obtained.

Pecten subconvexus, *spec. nov.* Plate xviii., fig. 2.

Irregularly orbicular, moderately convex, produced in front, radially ribbed. Ribs about 27, broad, truncated, considerably elevated, becoming thinner and subacute towards the sides; an indistinct appearance of three radial plications is produced by thicker ribs occurring close together in pairs. The interspaces between the ribs are as wide or a little wider than the ribs; they are concentrically sulcate, the intervening elevated threads are about equal in width to the sulci. Ears? Margin of the valve crenately undulate.

Dimensions.—Antero-posterior diameter, 30·5; umbo-ventral diameter, 31·5; sectional diameter of right valve, 5·5 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant !*).

Amongst recent species *P. subconvexus* is most nearly related to *P. convexus*, Quoy and Gaimard, from which it differs by the absence of radial folds, and the fewer, more distant, and flatter ribs; it is, moreover, less inflated. In a lesser degree it resembles *P. polymorphoides*, Zittel, which occurs at a lower geological horizon.

Lithodomus brevis, *spec nov.*

Lithodomus, sp., Tate, Trans. Roy. Soc., S. Australia, for 1885, p. 124.

Cylindrical, short; umbones tumid, incurved, submarginal; somewhat attenuated posteriorly, convexedly truncated anteriorly; post-dorsal margin very slightly arched, posterior margin rounded; ventral margin perceptibly incurved antemedially, the sloping anterior end making with the ventral margin an obtusely-rounded angle.

Surface marked with a few concentric ridges.

Dimensions.—Antero-posterior diameter, 21; greatest transverse diameter at the middle, 11; greatest sectional diameter through both valves at about half the total length, 11 millimetres.

Locality.—In crypts excavated in the coral *Plesiastræa Vincenti*, T. Woods, occurring at Hallett's Cove, St. Vincent Gulf.

This species is of about the same dimensions as *L. n. sp.* from Port Darwin, but the outline is not so curvated and the umbones do not project, or hardly at all, beyond the anterior margin.

Mytilus Hamiltonensis, *spec. nov.* Plate xviii., fig. 9.

Oblong-subtrigonal, angled, uncinate. Ornamented with very numerous frequently bifurcating radial threads, which are inconspicuously elevated, somewhat flatly rounded, separated by narrower interspaces; crossed by slender and close-set lines of growth.

Inner margin of valves denticulated all round. There are two or three small teeth under the umbo in the right valve. The anterior adductor scar is raised on a prominent boss, almost within the umbonal cavity. The byssal insinuation is of moderate size.

Dimensions of a moderate-sized example:—Umbo-ventral diameter, 47; length of hinge, 23; sectional diameter, 19; length of posterior margin, 33 millimetres.

Locality.—Upper beds at Muddy Creek (*R.T.* and *J. Dennant!*).

This fossil has the general appearance of the living *M. hirsutus*, Lamk., though slightly different in outline, the anterior and posterior margins being nearly straight and parallel, whilst in *M. hirsutus* they are concave and convex respectively;

the area anterior to the umbonal ridge is not so precipitous, and the ridge is not so elevated as in the recent species. The radial threads are not so elevated, and are separated by narrower furrows; the concentric ornament is, moreover, finer. The anterior adductor boss is peculiar.

When describing *Septifer fenestratus* I had only one specimen of *Mytilus Hamiltonensis* before me, which I then regarded as an adult shell of that species; the observations published thereupon should be erased from the diagnosis of *Septifer fenestratus*. These refer to the filling up of the umbonal cavity and the dimensions of the shell.

Mytilus linguatulus, *spec. nov.* Plate xix., fig. 3.

Narrowly oval, rather compressed; umbones uncinate; anterior margin nearly straight, the dorsal and posterior margins forming an interrupted curve; anterior side very narrow, descending abruptly from the low umbonal ridge. The surface is ornamented with elevated rounded radial threads, rather narrower than the flat furrows, and strong folds of growth and fine concentric wrinkles. The margin of the valves is crenulated all round. There is an elongated tooth under the hinge; and the anterior adductor is raised on a prominent boss. The byssal insinuation is inconspicuous.

Dimensions.—Umbo-ventral diameter, 48; greatest transverse diameter at right angles, 19; sectional diameter, 16 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*)

This species is very like *M. rostratus*, Dunker, but wants the angulation of the dorsal margin; the beaks are more produced, slightly excavated, not swollen, beneath and in front of the umbo; it has one long tooth in place of two or three short ones, and the anterior adductor boss is peculiar.

Mytilus deperditus, *spec. nov.* Plate xix., fig. 1.

Oblong; test thick, especially about the umbo, which is obtuse and swollen. Surface ornamented with strong folds and striæ of growth. Margin of valve plain; hinge with one large tooth.

Dimensions. — Umbo-ventral diameter, 80; transverse diameter towards the extremity of the hinge line, 35; sectional diameter of one valve, 16; length of hinge line, 60 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*)

M. deperditus resembles *M. latus*, Chemnitz (non Lamarck), but presents the following differential characters:—Narrower, the anterior side steeper, straighter, and longer hinge lines, stronger growth-folds, and convex, not concave, under the umbo.

Leda vagans, *spec. nov.*

Synonym.—*L. lucida*, Tenison-Woods; see Part I. (non Loven, id. Jeffreys, Brit. Conch.).

FAMILY ASTARTIDÆ.

Genus Carditella.

Micromeris rugosa, *M. radiata*, and *Gouldia lamellata*, described in Part I., prove to be congeneric, and may find a place in Mr. E. A. Smith's genus *Carditella*, rather than in *Micromeris* of Conrad.

The dentition is as follows:—

The *right valve* has one triangular subcentral tooth; a longitudinal posterior tooth separated from the margin by a deep furrow. The *left valve* has two divergent cardinal teeth, and a longitudinal anterior tooth separated from the margin by a shallow furrow.

The acute posterior edge of the left valve is received in the furrow of the right valve, and the acute anterior edge of the right valve fits into the furrow of the left valve; in consequence of this the right valve overlaps the left valve on the posterior hinge line, and the left overlaps the right on the anterior hinge line.

In *C. radiata* the lateral teeth and furrows are transversely striated, and there is sometimes developed a small supplementary laminate cardinal tooth in either valve.

Two new species are here added.

SYNOPSIS OF THE SPECIES.

Shell trigonal.
- Ornament of fimbriated imbricating lamellæ. *C. rugosa.*
- Ornament of radial ridges and simple folds. *C. radiata.*
- Surface smooth, slightly inequilateral. *C. polita.*

Shell subquadrangular.
- Ornament of 20 thin lamellæ. *C. lamellata.*
- Densely lamellated. *C. multilamella.*

Carditella polita, *spec. nov.* Plate xx., figs 20 and 21.

Shell trigonal, compressed with produced rather straight umbones; the young shells are equilateral, but in the adult the anterior side is slightly produced. The surface is polished, indistinctly marked with concentric lines. The inner margin of the valves is finely crenulated all round. The cardinal tooth in the right valve is stout and sulcated on the crown as in *C. radiata*.

Dimensions.—Antero-posterior and umbo-ventral diameters, 2·5 millimetres.

Locality.—Lower and upper beds at Muddy Creek; gastropod bed, River Murray Cliffs near Morgan.

Carditella multilamella, *spec. nov.* Plate xx., fig. 17.

This species is similar to *C. lamellata*, but it differs by its ovately-oblong form, and the stoutish recurved, numerous lamellæ. It might be overlooked for the fry of *Chione Cainozoica*.

Dimensions.—Antero-posterior diameter, 3; umbo-ventral diameter, 2·5; sectional diameter of one valve, ·75 millimetres.

Locality.—Lower beds at Muddy Creek.

Cardita solida, *spec. nov.* Plate xx., fig. 18.

Subtrigonally cordate, very thick, moderately convex, subequilateral, both ends obtusely rounded. The dorsal margin is considerably oblique on both sides of the prominent umbo, which is well curved over towards the front; the lunule is depressed, cordiform; the ventral margin is much curved. It is ornamented with eighteen radial ribs, which are stout, rounded, and almost smooth; the interspaces are a little broader than the ribs, transversely stoutly lirate. Margin strongly plicated.

Dimensions.—Antero-posterior diameter, 6·5; umbo-ventral diameter, 6·5; sectional diameter of one valve, 2·5 millimetres.

Locality.—Upper beds at Muddy Creek (*J. Dennant!*).

This new species has some affinity with the Tasmanian *C. Gunnii*, Desh., and *C. bimaculata*, Desh., but the shape is different, in which particular, however, it agrees with *C. Beddomei*, E. A. Smith, differing from it by the fewer non-nodulose ribs.

Cardita calva, *spec. nov.* Plate xx., fig. 14.

Ovately-subtrigonal, subequilateral, moderately depressed; rounded anteriorly, truncatedly rounded posteriorly. Umbones prominent, acute, slightly incurved; lunule depressed, broadly lanceolate, smooth, with well-defined margins.

The umbonal area is smooth, with excentric distant sulcations, the rest of the surface of the valve radiately ribbed; ribs 20, covered with thick closely-set granulations; the interspaces on the medial part of the surface are linear or almost obliterated, becoming wider towards the anterior and posterior margins.

Dimensions.—Antero-posterior diameter, 5·25; umbo-ventral diameter, 5· ; sectional diameter of one valve, 1·5 millimetres.

Localities.—Older beds, Muddy Creek; well-sinking on Cooke's Plains, east of Lake Alexandrina.

The nearest ally to this species is *C. compacta*, Tate, but is slightly different in shape, and depressed, the gross ornament and smooth umbo especially distinguish it.

The Scaphopods of the Older Tertiary of Australia.

By Professor Ralph Tate, F.G.S., F.L.S.

[Read October 5, 1886.]

Genus Entalis.

SYNOPSIS OF THE SPECIES.

Longitudinally ribbed and transversely striated. *E. Mantelli.*

Surface smooth or transversely striated.

Dorsal slit short, triangular. *E. subfissura.*

Dorsal slit linear, long.

Shell curved, slender, smooth. *E. acriculum.*

Shell straight, with annular ridges. *E. annulatum.*

Entalis Mantelli, *Zittel.*

Dentalium sp., Mantell, Quart. Journ. Geol. Soc., vol. vi., p. 331, t. 28, f. 15.

Dentalium Mantelli, Zittel, Palæontologie von Neu Seeland, p. 45, t. 13, fig. 7, 1865; id., Hutton, Tertiary Fossils of N.Z., p. 4, 1873.

Dentalium tenuis and *D. irregularis*, Hutton, op. cit.

Shell from nearly straight to subarcuate, thick, round, gradually tapering. Ornamented with a variable number of longitudinal ribs (from about 20 to 50), which are angular posteriorly, but become more numerous and usually rounded as they approach the base, where they are almost obsolete; the ribs are for the most part of equal dimensions, but occasionally they are alternately slightly broad and narrow; the interspaces are much narrower than the ribs, sometimes almost linear. The whole surface crossed by annular threads and slight grooves, coincident with the aperture, which produce slight crenulations on the longitudinal ribs. Aperture circular, with a thin edge. Fissure very long and narrow.

Dimensions of a moderately large example:—Length, 50; diameter of aperture, 5; length of fissure, 5 millimetres; but attaining to a length of 70, with a breadth of aperture of 7 millimetres.

Localities.—Very abundant at most of the localities—Gastropod bed of the River Murray Cliffs near Morgan, in a well-sinking at Nine-mile Camp, near Nor'-West Bend; lower beds at Muddy Creek; in the calciferous sandstone at Corio Bay; in the blue clays at Schnapper Point, Port Phillip; in the Turritella clays at Blanche Point, Aldinga Bay; and in the glauconitic clayey sands in the Adelaide bore; Table Cape (*Tenison-*

Woods). Also in the Oamaru and Pareora Series, New Zealand.

This common species in the Older Tertiary strata of Australia has been identified with *D. Mantelli*, equally common in New Zealand, after a comparison of authentic specimens. Prof. Hutton has merged his *D. irregularis* with that species, and I cannot find any distinctive characters for his *D. tenuis*, specimens of which I have had under examination. However, none of the New Zealand specimens which I have seen have the apex preserved, and no mention is made by either Zittel or Hutton of the presence or absence of an apical slit.

The ornament of the test of *D. Mantelli* is so exceedingly variable in respect to the number, size, and shape of the longitudinal ribs that it becomes difficult to select diagnostic characters. In two examples of equal length taken at random the number of ribs at the base of the slit is 17 and 20, increasing at the anterior end to 26 and 50 respectively. Examples from Aldinga have much finer transverse threads.

D. giganteum, Sowerby (in Darwin's Geol. Obs. on S. America), of which *D. solidum*, Hutton, is a synonym, is distinct, though conspecific with *D. Mantelli*.

The Rev. J. E. Tenison-Woods gave the name of *D. Kicksii*, Nyst, to a Table Cape fossil, and from his description of it there cannot be a doubt of its identity with *D. Mantelli*, Zittel. The very brief diagnosis of the Belgian fossil does not permit an identification.

Entalis subfissura, *spec. nov.* Plate xx., figs. 4*a*.—4*b*.

Shell thin, subulate, moderately curved, slightly compressed dorso-ventrally, smooth, polished; faintly marked with annular striæ (visible under a lens) and growth ridges. Apical fissure a shallow triangular notch, the embryonal projecting tube prominent.

Dimensions.—Length, 46; dorso-ventral and transverse diameters of aperture, 4 and 4·25 millimetres respectively.

This species has the general aspect of *Entalis fissura*, Lamk., of the Paris Basin, but the apical fissure is linear and not triangular. It may be conspecific with *D. lævis*, Hutton, but that species is too incompletely known to permit of satisfactory identification.

Localities.—Gastropod bed of the River Murray Cliffs near Morgan, and well-sinking at Nine-mile Camp, near Nor'-West Bend; Muddy Creek, Corio Bay, and Schnapper Point, Victoria; Turritella clays at Blanche Point, Aldinga Bay.

Entalis annulatum, *spec. nov.* Plate xx., figs. 6*a*—6*b*.

Shell nearly straight; test thick, smooth, polished; orna-

mented with close set, depressed, annular ridges, barely visible by the unaided eye.

Dimensions.—Length, 74; diameter of anterior aperture, 6·5 millimetres.

Locality.—Muddy Creek.

Entalis acriculum, *spec. nov.* Plate xx., fig. 11.

Shell thin, subulate, very slightly curved, smooth, polished; marked with annular striæ (visible under a lens); oral aperture circular; posterior aperture with a longish, linear fissure.

Dimensions.—Length, 33; diameter of anterior aperture, 2·5 millimetres.

Locality.—Lower beds at Muddy Creek.

Genus Dentalium.

SYNOPSIS OF THE SPECIES.

Longitudinally six to eight sulcated. *D. aratum.*
Longitudinally ribbed posteriorly, smooth anteriorly. *D. (?) bifrons.*
Without longitudinal ornament; round, stout. *D. lacteum.*
Trigonal, slender. *D. (?) triquetrum.*

Dentalium aratum, *spec. nov.* Plate xx., fig. 8.

Shell small, slightly curved; acutely regularly 6 to 8 angled (usually 8); interspaces concave with a few slender longitudinal riblets and striæ, and close-set, fine, transverse striations.

The ornament varies in the acuteness and strength of the ribs, and therefore in the depth of the interspaces; in some specimens, by reduction in volume of the primary ribs and the increased size of the intermediate ones, the anterior part is subrotund and multicostated.

Dimensions.—Length, 20; diameter of anterior aperture, 2 millimetres.

Localities.—Gastropod bed of the River Murray Cliffs near Morgan; lower beds at Muddy Creek; blue clays at Schnapper Point; Muloowurtie yellow clays near Ardrossan.

D. nanum, Hutton, is similar to this species, but its ribs vary from 8 to 13, and the interspaces are smooth.

Dentalium (?) bifrons, *spec. nov.* Plate xx., fig. 5.

Shell thin, round, nearly straight, posteriorly longitudinally ribbed, anteriorly smooth.

The ribs are slightly elevated, subangular, about 40 in number, sometimes they are alternately stout and slender, becoming more depressed, and finally disappearing at about one-third the total length from the apex; the anterior portion is

ornamented with very fine annular striæ, and a few ridges of growth.

Apex unknown.

Dimensions of the longest example.—Length, 92 (estimated at 100) ; diameter of anterior aperture, 9 millimetres.

Locality.—Upper beds at Muddy Creek.

The costated portion differs from *E. Mantelli* in not having the tessellated ornament; it is similar to *E. brevifissum*, Deshayes, of the Paris basin, but the ribs are only about 15, and to *E. substriatum* of the same author, but the apical part of that shell is finely striated.

Dentalium (?) triquetrum, *spec. nov.* Plate xx., fig. 3.

Shell very attenuated, rather thick, very slightly curved; extremely flattened laterally, so that the transverse section is an isosceles triangle, the angle on the convex side more rounded than those formed by the flattish concave face and the sides; the perpendicular from the convex side is a little longer than the base.

The surface is polished, ornamented by a few wavy undulations and microscopic striæ.

Dimensions.—Longer diameter of aperture at each end in a length of 10 millimetres, ·75 and ·5 millimetres respectively.

Locality.—Glauconitic sands, Adelaide bore.

Dentalium lacteum, *Deshayes.*

Reference.—Mon. Gen. Dentale, 1825, t. 16, f. 28.

The Rev. J. E. Tenison-Woods (Proc. Roy. Soc., Tasm., for 1875, p. 17) identified a Table Cape fossil with the above-named species living in the Indian Seas. I have not seen a specimen from the Tasmanian locality, but a common shell in the Muddy Creek beds agrees well with the figure, measurements, and description given by Deshayes. The original diagnosis is as follows:—Round, not slit at the posterior extremity, slightly arched, very smooth, very shining, subtranslucent; length, 30; diameter at aperture, 2·5 millimetres.

Cadulus mucronatus, *spec. nov.* Plate xx., fig. 10.*

Long, narrow, slightly bent; slightly swollen at a little nearer the anterior than the posterior end, more conspicuously so on the convex curve, which is a little nearer to the posterior end than is the bulging on the concave curve. Anterior to the inflation the tube is slightly laterally compressed. The mouth is slightly oblique, oval, with a thin and sharp edge; the posterior opening is round, thickened within, and bevelled to a sharp edge, inconspicuously mucronately produced on the con-

*A very imperfect representation of the shell.

vex side corresponding with a faint internal rib, and slightly insinuated laterally. Surface smooth, polished, microscopically concentrically and with faint indications of opaque transverse bands.

Dimensions.—Length, 7; diameter at swelling, 1·25; of mouth, ·9 millimetres.

Locality.—Not uncommon in the lower beds at Muddy Creek.

The outline of the shell is like that of *C. gracilis*, Jeffreys, but the shell is very much larger, and is otherwise very different.

Cadulus acuminatus.

Slightly curved, tapering at both ends, enlarging more rapidly posteriorly than anteriorly, but not at all bulging; surface smooth and shining; microscopically concentrically striated. Mouth circular, slightly oblique, thin; posterior opening circular, small, the edge thick,

Dimensions.—Length, 6; diameter at the middle, 1; of mouth, ·75 millimetres.

Locality.—Oyster beds of the Upper Aldinga series.

The species is not uncommon in shell sand on the shores of St. Vincent Gulf.

The Pteropods of the Older Tertiary of Australia.

By Professor Ralph Tate, F.G.S., F.L.S., &c.

[Read October 5, 1886.]

Genus Styliola.

SYNOPSIS OF THE SPECIES.

Without conspicuous ornament.	
Sides rounded; a dorsal furrow.	*S. Rangiana.*
Sides angulated; no dorsal furrow.	*S. bicarinata.*
Transversely annulated.	*S. annulata.*

Styliola Rangiana, *spec. nov.* Plate xx., fig. 2.

Shell slender, conical, pellucid; straightish, but slightly curved apically, and rather abruptly tapering to a fine point; in front of the apex are one or two small inflations; slightly compressed dorso-ventrally; ornamented with obliquely transverse striæ. A longitudinal sulcus extends from the aperture

on its dorsal side only, inclining to the left of the middle line to near the apex. Aperture oblique, ovate-rotund.

Dimensions.—Axial length, 5·5; major diameter of aperture, 1·25 millimetres.

Localities.—Muddy Creek and Schnapper Point, Victoria.

Compared with actual specimens of *Cleodora subulata*, Quoy and Gaimard, this species is distinguished by its elliptical aperture, by its proportionately greater breadth, and by its abruptly tapering apex.

Styliola bicarinata, *spec. nov.* Plate xx., fig. 9.

Shell slender, conical, pointed, straight; aperture transversely ovate; lateral margins strongly keeled.

Dimensions.—Axial length, 6·25; major diameter of aperture, 2 millimetres.

Locality.—Muddy Creek.

Styliola annulata, *spec. nov.* Plate xx., fig. 1.

Shell conical, straight, transversely annulated, smooth; aperture circular.

Dimensions.—Axial length, 8; diameter of aperture, 2 millimetres.

Localities.—Glauconitic clayey sands, Adelaide bore; Turritella clays, Blanche Point, Aldinga Bay.

This species presents some resemblance to *Creseis striata*, Rang, but the shell is straight, not incurved apically, and the annulations are on a larger scale.

Vaginella eligmostoma, *spec. nov.* Plate xx., fig. 7.

Elongate-ventricose, smooth, shining, apex acute; the posterior half is subcompressed, angulated on the sides, thence narrowing to near the aperture, where the shell expands laterally, though here the lateral compression is most distinct.

The sculpture consists of very fine arched striæ descending to the lateral angulations.

The aperture is narrowly oval-oblong, with truncatedly rounded ends; each lip has a median curvature bounded on each side by a broad insinuation.

Dimensions.—Total length, 7; greatest transverse diameter, 1·75 millimetres.

Locality.—Very abundant in the lower beds at Muddy Creek.

This species would appear to be distinct from *V. depressa*, Basterot, of the Miocene Basin of Bordeaux and Dax, chiefly by its sinuated aperture. Rang and Souleyet represent the aperture of *V. depressa* as having simple margins meeting at an angle.

Spiralis tertiaria, *spec. nov.* Plate xx., figs. 12*a*—12*c*.

Shell sinistral, thin, shining, transparent; subglobosely depressed, umbilicated. The last whorl is convex, rapidly enlarging, regularly curved, except near the suture, where it is rapidly descending; spire sunken, with the apical whorls rising to the level of the last whorl. Umbilicus small. Peristome thin, simple, a little reflexed at the umbilicus. Surface sculptured with fine sigmoid lines.

Diameter, one millimetre.

Localities.—Lower beds at Muddy Creek and blue clays at Schnapper Point.

Explanation of Plates.

N.B.—The figures are of the natural sizes except when otherwise stated.

Plate XIV.

1. Cardium Victoriæ, *Tate.* Muddy Creek. *a*, Left valve; *b*, enlargement of surface near the ventral margin.
2. Cardium hemimeris, *Tate.* Adelaide. *a*, Right valve; *b*, enlargement of portion of anterior half (not correct), and *c*, of posterior half.
3. Cardium moniletectum, *Tate.* Adelaide. *a*, Left valve; *b*, enlargement of surface.
4. Verticordia rhomboidea, *Tate.* River Murray Cliffs. Enlarged.
5. Chama lamellifera, *Tenison-Woods.* Schnapper Point. *a*, Attached valve; *b*, free valve.
6. Montacuta sericea, *Tate.* Muddy Creek. Enlarged.
7. Chione propinqua, *T. Woods.* Muddy Creek.
8. Chione propinqua, *T. Woods.* Table Cape.
9. Dosinia Johnstoni, *Tate.* Muddy Creek.
10. Diplodonta subquadrata, *Tate.* Muddy Creek. *a*, Left valve, and *b*, dorsal aspect of the same.
11. Dosinia imparistriata, *Tate.* Adelaide.
12. Dosinia Johnstoni, *Tate.* Muddy Creek. *a*, Left valve of an adult shell, and *b*, dorsal aspect of the same.
13. Verticordia pectinata, *Tate.* Muddy Creek. Enlarged.
14. Cytherea paucirugata, *Tate.* Muddy Creek.
15. Venerupis paupertina, *Tate.* Muddy Creek. Slightly enlarged.
16. Cytherea tenuis, *Tate.* Adelaide.
17. Chione subroborata, *Tate.* Muddy Creek. *a*, Left valve; *b*, dorsal aspect of right valve.

18. Cytherea Murrayana, *Tate*. River Murray Cliffs.
19. Loripes simulans, *Tate*. Aldinga. Slightly enlarged.

Plate XV.

1. Chione hormophora, *Tate*. Table Cape. *a*, Left valve; and *b*, its dorsal aspect.
2. Neæra subrostrata, *Tate*. Muddy Creek. *a*, Adult shell; *b*, young (?) shell. Much enlarged.
3. Chione dimorphophylla, *Tate*. River Murray Cliffs. *a*, Left valve; *b*, dorsal aspect of united valves.
4. Meroe gibberula, *Tate*. Muddy Creek. *a*, Right valve, and *b*, dorsal aspect of the same.
5. Thracia perscabrosa, *Tate*. Muddy Creek.
6. Chione multilamellata, *Tate*. Adelaide. *a*, Left valve; and *b*, dorsal aspect of the same.

Plate XVI.

1. Chione Corioensis, *Tate*. Corio Bay. Enlarged.
2. Chione dictua, *Tate*. River Murray Cliffs. Slightly enlarged.
3. Chione Cainozoica, *T. Woods*. Schnapper Point. *a*, Right valve; *b*, its dorsal aspect.
4. Tellina albinelloides, *Tate*. Muddy Creek. *a* and *b*, Left and right valves.
5. Tellina æquilatera, *Tate*. Muddy Creek. *a*, Left valve; *b*, interior of right valve.
6. Tellina Masoni, *Tate*. Muddy Creek. *a*, Left valve; *b*, right valve; *c*, dorsal aspect of left valve.
7. Tellina Stirlingi, *Tate*. Muddy Creek. *a*, Left valve, and *b*, its dorsal aspect. Enlarged.
8. Tellina porrecta, *Tate*. Adelaide. Slightly enlarged.
9. Tellina equilatera, *Tate*. River Murray Cliffs. *a*, Left valve of a very young shell (ventral margin too much arched); *b*, dorsal aspect of the same. Enlarged.
10. Psammobia æqualis, *Tate*. Muddy Creek. Slightly enlarged.
11. Donax depressus, *Tate*. River Murray Cliffs.
12. Semele vesiculosa, *Tate*. Muddy Creek. Slightly enlarged.
13. Psammobia Hamiltonensis, *Tate*. Muddy Creek.
14. Solecurtus ellipticus, *Tate*. River Murray Cliffs. Slightly enlarged.
15. Donax Dixoni, *Tate*. Muddy Creek. Enlarged.
16. Myodora angustior, *Tate*. Muddy Creek. Slightly enlarged.
17. Solecurtus Dennanti, *Tate*. Muddy Creek.
18. Semele Krauseana, *Tate*. Schnapper Point. *a*, Right valve; *b*, dorsal aspect of closed valves.

Plate XVII.

1. Mactra axiniformis, *Tate.* Muddy Creek. *a*, Right valve *b*, dorsal aspect of the same.
2. Jouannetia cuneata, *Tate.* Adelaide.
3. Mactra Howchiniana, *Tate.* Muddy Creek. *a*, Right valve; *b*, dorsal aspect of the same.
4. Mactra Hamiltonensis, *Tate.* Muddy Creek. *a*, Right valve; *b*, its dorsal aspect.
5. Anapa variabilis, *Tate.* Aldinga. *a*, Right valve; *b*, its dorsal aspect.
6. Myodora lamellata, *Tate.* Adelaide. *a*, Right valve; *b*, left valve; *c*, dorsal aspect of united valves. Enlarged.
7. Myodora lamellata, *Tate;* var. Adelaide. Right valve. Enlarged.
8. Myodora æquilatera, *Johnston.* Table Cape. Left valve.
9. Myodora tenuilirata, *Tate.* Muddy Creek. *a* and *b*, Right and left valves.
10. Myodora australis, *Johnston.* Table Cape. *a* and *b*, Right and left valves.
11. Myodora corrugata, *Tate.* Muddy Creek. *a* and *b*, Right and left valves.
12. Corbula pixidata, *Tate.* Aldinga. *a*, Left valve; *b*, dorsal aspect of united valves. Slightly enlarged.
13. Corbula ephamilla, *Tate.* River Murray Cliffs. *a*, Left valve; *b*, right valve; *c*, dorsal aspect of united valves.
14. Corbula ephamilla, *Tate.* Young shell, much enlarged.
15. Solecurtus Legrandi, *Tate.* Table Cape.

Plate XVIII.

1. Barnea tiara, *Tate.* Muddy Creek. *a*, Left valve; *b*, accessory valve; and *c*, side view of the same.
2. Pecten subconvexus, *Tate.* Muddy Creek.
3. Panopæa orbita, *Hutton.* River Murray Cliffs.
4. Pecten deformis, *Tate.* Muddy Creek.
5. Tellina Cainozoica, *T. Woods.* Table Cape. Slightly enlarged.
6. Cytherea submultistriata, *Tate*; var. Cooke's Plains.
7. Cytherea eburnea, *Tate.* River Murray Cliffs.
8. Cytherea submultistriata, *Tate.* Muddy Creek.
9. Mytilus Hamiltonensis, *Tate.* Muddy Creek.
10. Sacchia suborbicularis, *Tate.* River Murray Cliffs. *a*, Right valve, enlarged; *b* and *c*, interior of left and right valve, much enlarged.
11. Lucina affinis, *Tate.* River Murray Cliffs. Enlarged.

Plate XIX.

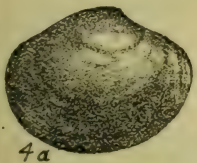
1. Mytilus deperditus, *Tate.* Muddy Creek.
2. Solen sordidus, *Tate.* Muddy Creek.
3. Mytilus linguatulus, *Tate.* Muddy Creek.
4. Teredo sp. Muddy Creek. Enlarged.
5. Cryptodon mactræformis, *Tate.* Muddy Creek. Much enlarged.
6. Strigilla australis, *Tate.* Muddy Creek. Slightly enlarged.
7. Rhinomya latesulcata, *Tate.* Adelaide. Much enlarged.
8. Neæra Adelaidensis, *Tate.* Adelaide. Enlarged.
9. Lucina aræa, *Tate.* Aldinga. Enlarged.
10. Ostrea manubriata, *Tate.* Muddy Creek. Exterior and interior views of the attached valve.
11. Aspergillum (Humphreyia) liratum, *Tate.* Adelaide. Slightly enlarged.
12. Myodora prælonga, *Tate.* Muddy Creek. *a*, Right valve; *c*, its dorsal aspect; *b*, left valve; *d*, interior of the same.
13. Kellia micans, *Tate.* Muddy Creek. Enlarged.
14. Capistrocardia fragilis, *Tate.* River Murray Cliffs. *a*, Interior, and *b*, exterior of left valve. Enlarged.

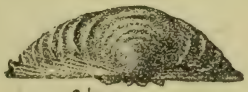
Plate XX.

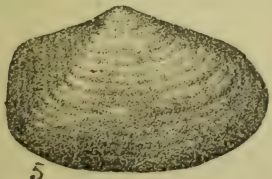
1. Styliola annulata, *Tate.* Aldinga. Enlarged.
2. Styliola Rangiana, *Tate.* Muddy Creek. Much enlarged.
3. Dentalium triquetrum, *Tate.* Adelaide. Enlarged, natural size in outline.
4. Entalis subfissura, *Tate.* River Murray Cliffs. *a*, Natural size; *b*, apex enlarged.
5. Dentalium bifrons, *Tate.* Muddy Creek.
6. Entalis annulatum, *Tate.* Muddy Creek. *a*, Natural size, and *b*, apex enlarged.
7. Vaginella eligmostoma, *Tate.* Muddy Creek. Much enlarged; aperture in outline.
8. Dentalium aratum, *Tate.* River Murray Cliffs. Enlarged; natural size and transverse section in outline.
9. Styliola bicarinata, *Tate.* Muddy Creek. Enlarged; natural size and section in outline.
10. Cadulus mucronatus, *Tate.* (A very bad drawing.)
11. Entalis acriculum, *Tate.* Muddy Creek. Natural size, and apex enlarged.
12. Spiralis tertiaria, *Tate.* Muddy Creek. *a*, Base; *b*, front view; *c*, apical aspect. Much enlarged.
13. Lucina araneosa, *Tate.* Muddy Creek. Enlarged.
14. Cardita calva, *Tate.* Muddy Creek. Enlarged.

15. Lucina despectans, *Tate.* Muddy Creek. Young shell, much enlarged.
16. Lucina despectans, *Tate.* An older shell, enlarged.
17. Carditella multilamella, *Tate.* Muddy Creek. Enlarged.
18. Cardita solida, *Tate.* Muddy Creek. Enlarged.
19. Tellina equilatera, *Tate.* Muddy Creek. An adult shell.
20. Carditella polita, *Tate.* Muddy Creek. Fry, much enlarged.
21. Carditella polita, *Tate.* An adult shell, enlarged.

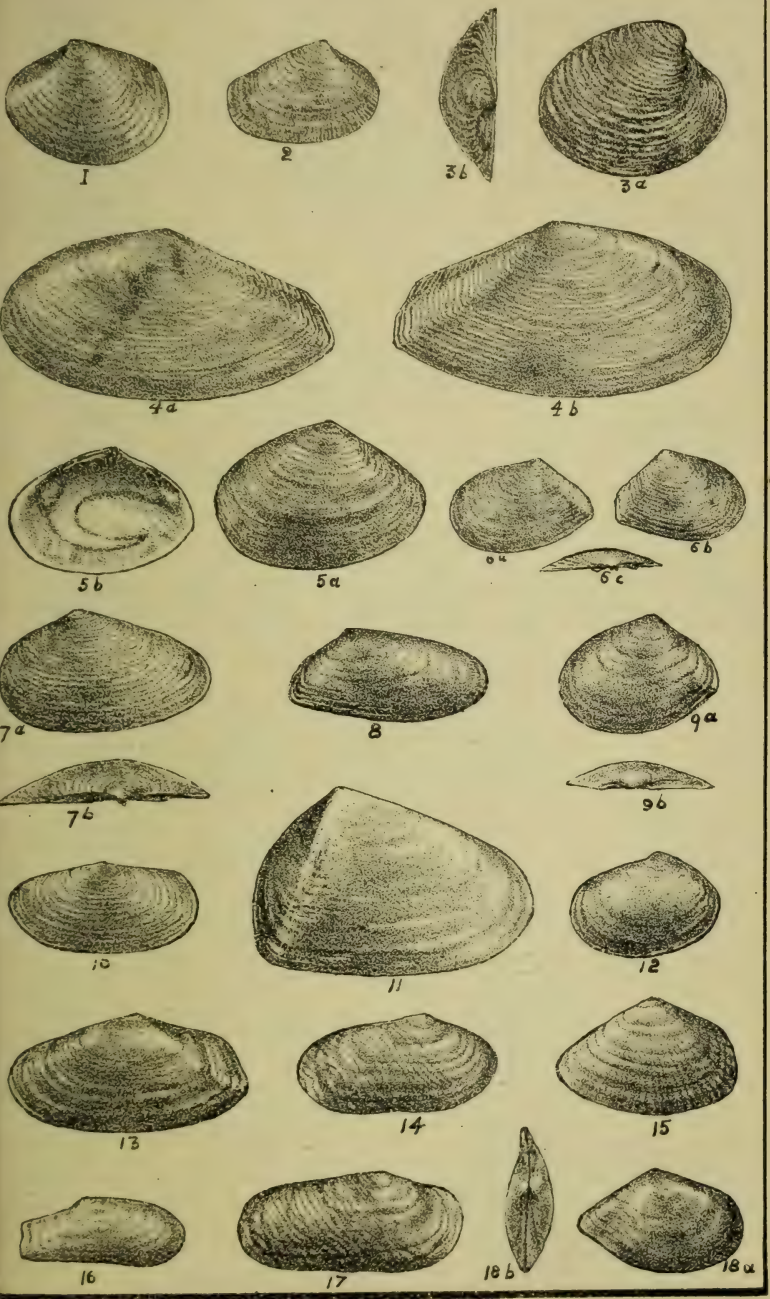
W.J CHIDLEY DEL



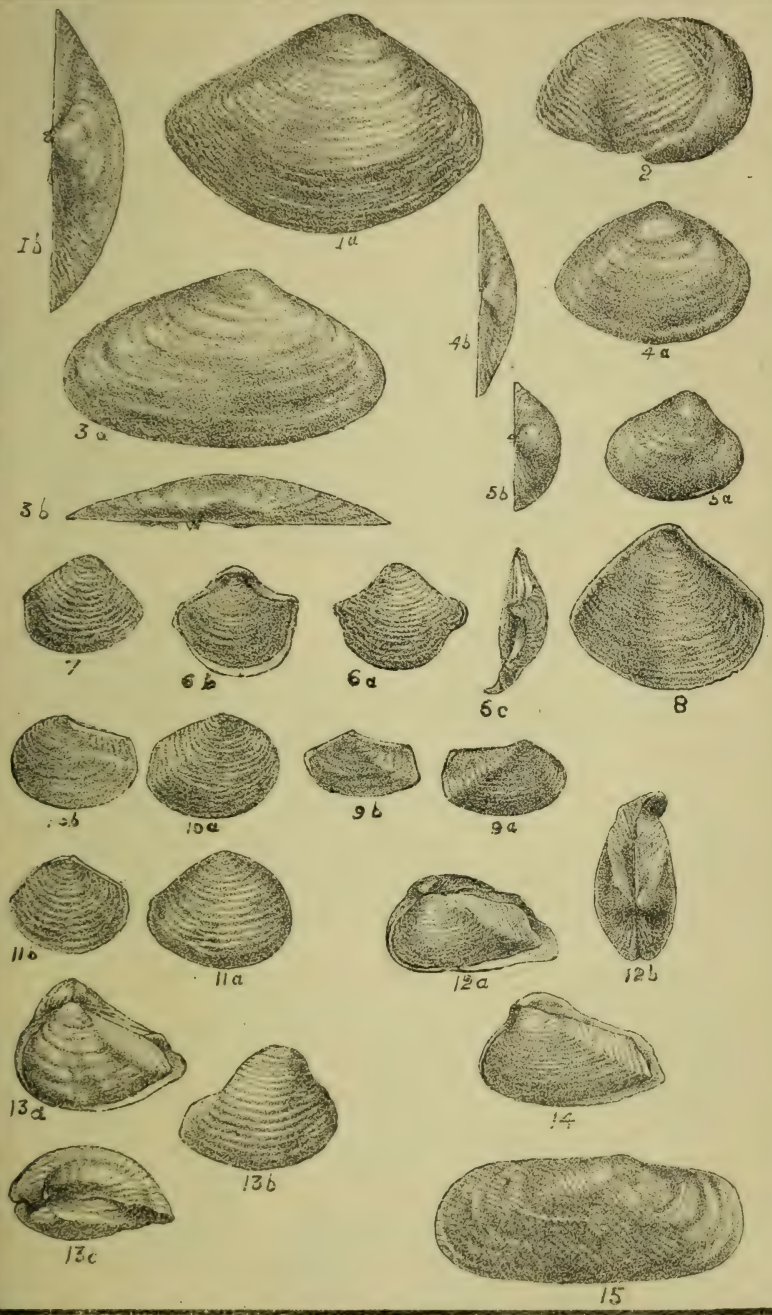




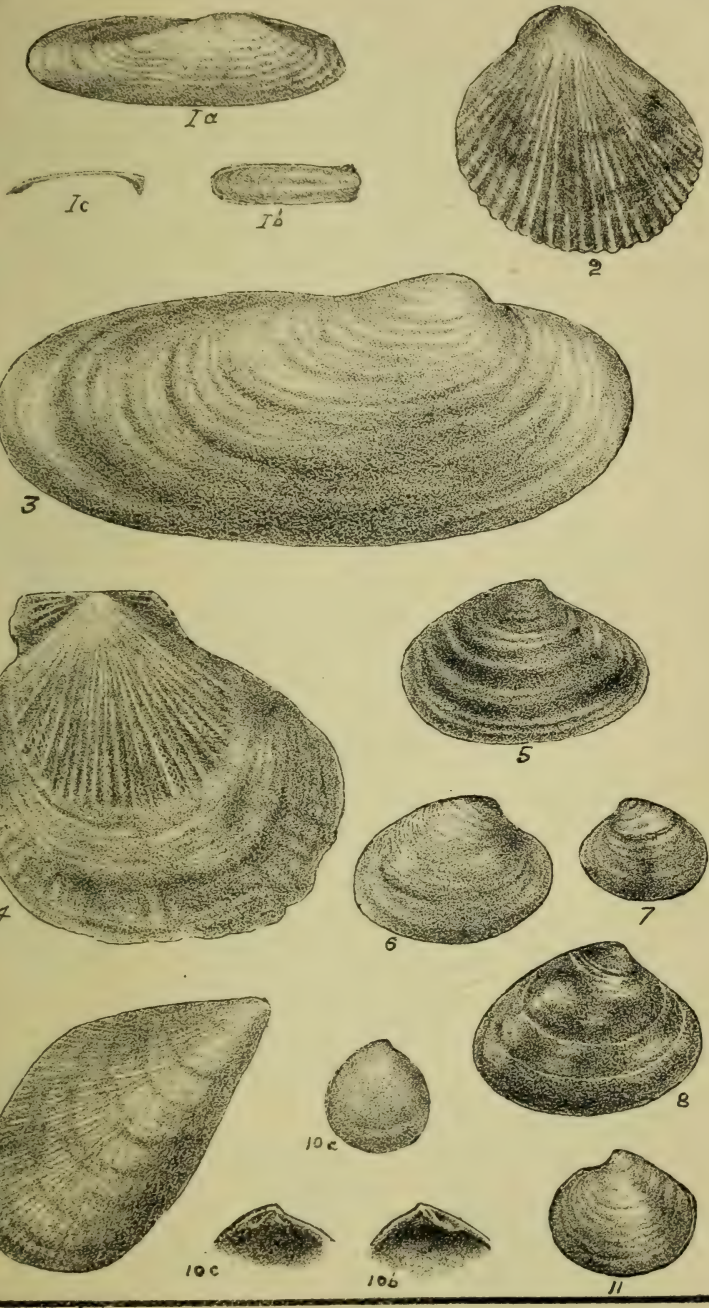
W J.CHIDLEY DEL



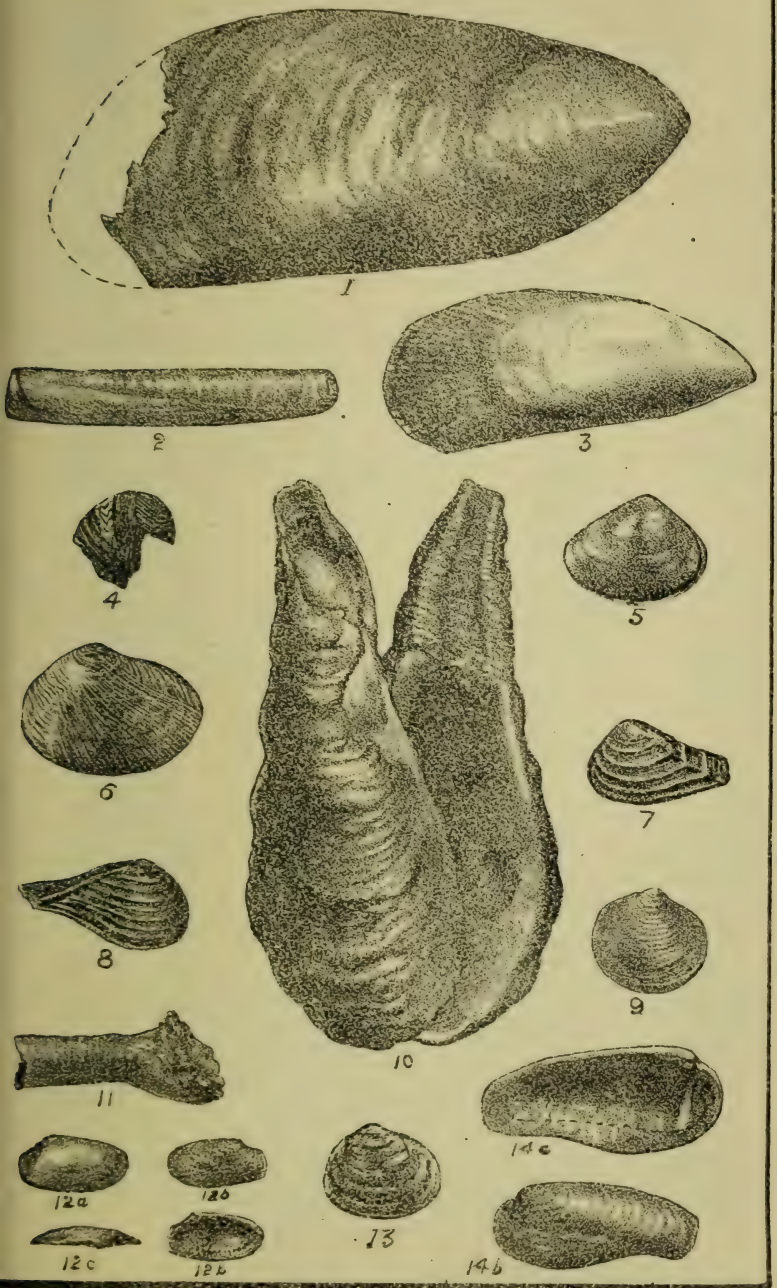
W.J. CHIDLEY. DEL.



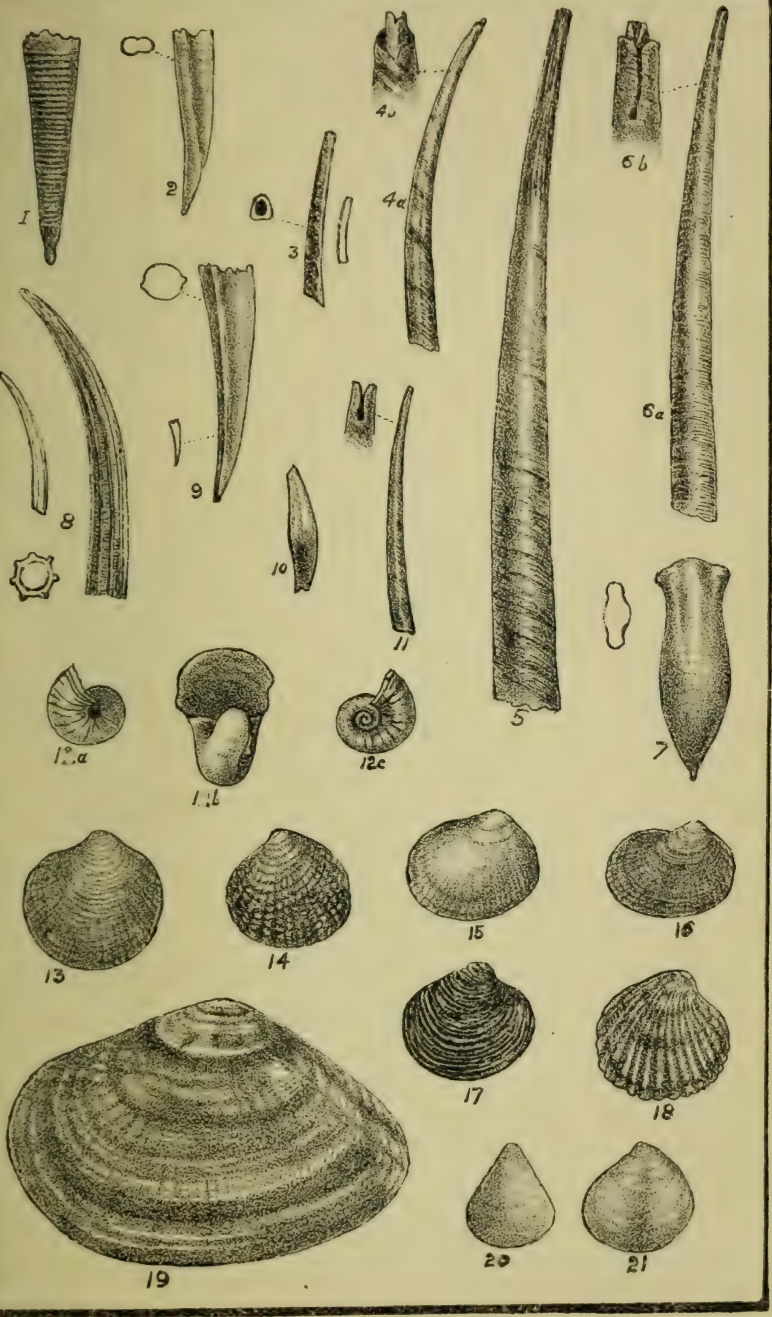
W.J CHIDLEY DEL



W.J. CHIDLEY DEL.



J. CHIDLEY DEL



W.J. CHIDLEY. DEL.

Scientific Observations made during the Voyage of the Maranoa from London to Adelaide, 1883.

By Clement L. Wragge, F.R.G.S., F.R.Met.Soc., &c.

[Read June 2, 1885, and March 2, 1886.]

Plates XXI.-XXVI.

(abstract.)

We left Portland at 6.40 a.m., October 20th, and I at once proceeded to arrange my instruments. I employed an ordinary Stevenson's thermometer screen, and strongly recommend it for sea use in place of the Board of Trade wall screens, usually supplied to captains by the Meteorological Office. By means of it I obtained a better circulation of air around the bulbs than is possible with a wall screen, and I hung maximum and minimum thermometers therein, as well as wet and dry bulbs. Self-registering thermometers I find very necessary at sea, and the screen should be swung to a spar in such a way as to keep its perpendicular position, and if placed in the afterpart of the ship, near the taffrail, a good series of observations can be obtained, and the index in the minimum thermometer will not slip. Here the chance of vitiation of readings, either by spray or heat from the engine-room, is reduced to its minimum. In my cabin I swung a "Richard" aneroid barograph, a new form of recording barometer, which I can most cordially recommend. The instrument only needs setting and winding once a week, and a perfect and most valuable record of pressure is obtained throughout the voyage. My own mercurial, a fine Board of Trade barometer, having a total error of but 0·003, I also hung in my cabin, and my floating observatory was as complete as I could make it. I also determined to take sea-surface temperatures throughout the voyage, as this is one of the most important points in the problems of physical geography, and I found the best plan was to cast a little bucket from near the forecastle head, so as to be clear of the disturbing influences from the waste-pipes of the engine-room. At noon on October 20th, 28½ miles south-west from Portland, I took my first regular readings. Observations were usually made at "eight bells."

It is always my custom at sea to cast adrift bottles containing the ship's position, with a request to the finder to report where

picked up, in the hope of obtaining novel results as to the currents of the ocean. This practice was adopted during the Antarctic expeditions with much success, and I have already obtained valuable data from my own bottles sent adrift on former voyages.

After passing Ushant the Maranoa came into the region of Rennel's current, a stream much influenced by the seasons and winds. It follows the north coast of Spain, then sets north along the west of France, and runs at the rate of more than half a mile per hour. It passes the entrance of the English Channel, where it flows at a velocity of a mile an hour, and to it is attributed the loss of many vessels. One branch sets to Cape Clear, and another to St. George's Channel.

In lat. 46° 30′, long. 7° 10′ W., where the current sweeps up from the Bay of Biscay, I cast over three bottles addressed to the Meteorological Office, in the hope of testing seasonal change on this current. It appears, however, from my experiments of a *former* voyage—which I may mention as of passing interest—that bottles do not always drift with the current, but may to a greater extent than in the opinion of Maury be influenced by the winds. For instance, on May 17th, 1878, when in lat. 48° 19′ N., long. 10° 27′ W., a position somewhat to the *west* of this current, I cast over bottles under west-south-westerly winds. These, instead of following the drift, which is strong with west winds, went easterly, right across it, without loss of time. One was picked up on the island of Sein on July 12th, one in the Baie de Quiberon about August 21st, another on the coast of the Department of Finistère, and a fifth went up channel to Brighton Beach, and was picked up on October 8th following. On the present voyage, in lat 45° 40′ N., long. 7° 50′ W., where the Biscay current setting to east-south-east joins the loop of Rennel's current setting to west-north-west, I cast over a bottle, and in like manner it did not follow the current, but went right across it nearly at right angles, and was picked up four months afterwards on the coast of the Department of Loire-Inférieure.

Early on October 22nd we sighted the steep and broken coast line of North-West Spain, a formation which I connect with the Cretaceous period. I was enabled to take several sketches of this interesting scenery with its fiord-like inlets or *rias*. The action of sub-aerial denudation is very apparent in the rounded bluffs of Finisterre, and *débris* from the weathering action of Atlantic storms is seen in many a talus on the wild declivities of this littoral. Near Cape Carvoeiro the weathering action on the ruddy white chalk is again very apparent, and masses of *débris* cover the cliffs.

When passing near Lisbon another bottle was sent adrift.

The Maranoa was then in the Portugal current which flows from Cape Finisterre, then south-south-east, coming very near to the coast, and after rounding Cape St. Vincent joins that portion of the North African current which enters the Mediterranean. I expected that my bottles would have followed this course, and was much surprised when, through the kindness of Messrs. Blandy, of Madeira, I received the original bottle-paper which had, instead, travelled south-west, and was picked up by fishermen on the south beach of Porto Santo barely three months afterwards (January 14th, 1884). Messrs. Blandy in their letter to me say—"It is a strange thing it having turned up there, as we have very distinct proofs of the current running usually from north-west past our group of islands. From Christmas until 15th January, however, we experienced a very unusual spell of south-east winds veering continually between east and south, and evidently of abnormal influence."

The mountainous ridge terminating in Cape Spartel is an imposing feature of much interest to the geologist. Alternating, however, with the bold escarpments of this portion of the coast are low and undulating tracts, evidently the waste material from the softer parts of what was once a higher range.

The following sea-surface temperatures are worthy of special note:—On October 23rd at 8 p.m, on coming up to Cape St. Vincent, 60·4° was the value. At 8 a.m. next day when passing abeam of the mouth of Guadalquiver, and about 80 miles distant, 65·0° was recorded. At noon, when 40 miles from Cadiz, the temperature of the water had fallen 3·2°, and afterwards appeared steadily to rise till 66·0° was registered at 8 p.m. in the Strait. The discharge of the waters draining the heated plains of Andalusia, and the influence of the converging land, may tend to explain these temperatures.

The famous "red glow" was first noticed at sunset on the 30th October. East of the 24th meridian intense vapour bands were observed to the left of D in the spectrum throughout the day at seven degrees above horizon. At times these bands were almost black, but usually faded off with elevation of the instrument to the zenith. This extraordinary intensity of the rain-band in the clear skies of the Levant I attribute to the excess of vapour accumulated over the sea, and rapid evaporation, and cannot establish a connection between them and the sunset displays.

Port Said was reached on the morning of November 1st, and soon afterwards we entered the Suez Canal.

I was much gratified to find that since my last passage through the Canal (in 1874) a belt of vegetation had sprung up on many parts of the banks, acting as a natural barrier to the sand-dust, which otherwise would drift rapidly into the

bed of the canal. *Arundo phragmites*, *gnaphalium*, and a species of lotus appear to prevail. At Ismailia I went ashore by special arrangement, and on the shores of Lake Timsah I obtained many specimens of marine mollusca, including *Cardium edule*, *Mactra solida*, and *Mytilus*, which the Arabs affirmed had migrated from the Red Sea.

The maximum air temperature during the passage of the Canal was 77·3, and the minimum 61·0°. The barometer, fully reduced, ranged between 30·080 and 29·904 during the passage of the Canal.

I may mention that the highest sea surface temperature yet observed is 94° near the Strait of Bab-el-mandeb. On looking at the synopsis of this section it will be seen that 88·9° was the highest observed on this passage in lat. 17° 45′ N. The mean temperature of the Red Sea water north of latitude 20° is 77° 4′, and south of that parellel 81° 5′. In many parts of the Red Sea the water is intensely blue, the colour being quite as deep as in the Mediterranean. I observed this more particularly in lat. 26° 20′ N. The cause of this blue colour appears as yet to be imperfectly understood, and probably will remain so until the perfection of a sub-aqueous exploring telescope, as suggested by Sir J. F. W. Herschel, Bart., in the fourth edition of the "Admiralty Manual of Scientific Enquiry," has been realised.

At Aden I secured several specimens of metamorphic slates and calcite with some pieces of tracytic or felspathic lava.

We sailed from Aden on November 8th as the north-east monsoon was becoming established, and on 10th we passed Socotra, an admirable position for a high-level meteorological station by the way, being 4,656 feet high. In this neighbourhood I observed many fine specimens of *Acalephæ*, purple "jelly-fish," probably the *Æquorea purpurea*. They abounded in great numbers. *Exocietas volitans* was also prevalent. Here again the water was of a deep blue colour. Intense vapour bands were observed during this section to the left of the D line in the spectrum at 7° above horizon as in the Mediterranean and Red Sea.

The prevailing upper wind current was N.E. by E., the clouds travelling with a velocity of about 2·5 on a scale of 0 to 10. The skies of the north-east monsoon are truly splendid, and the cloud-forms often exceedingly curious. One instance only I can mention. On November 14th, after sunset, against a golden background, rose as from the offing dark cumuli of most grotesque shapes. They resembled trees, branches, islands, rocks, and even solar prominences, with heavy cumulo-stratus stretched above, while the full moon at the opposite azimuth, on a sky of grey blue and reflected on the water, added charm to the picture. I merely mention this because many travellers

having a knowledge of photography might add very largely to meteorological science by taking cloud pictures in various latitudes.

The high values for relative humidity at sea will interest those who have not given special attention to meteorology, especially when it is remembered that 25 and 15 are not unusual percentages for this element in the dry summer climate of the Adelaide Plains. In the latter a percentage of nine, with a difference of over 36° between the dry and wet bulbs, has quite recently been recorded at the Torrens Observatory, lately established by me, two miles north-east from Adelaide.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.*	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud scale, 0 to 10	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Oct.																
20	4 to 8 p.m.	—	—	—	—	—	—	—	W.	31	Types of cumulus.	—	c	50·8	—	About 60 miles N.E. from Ushant.
20	8 p.m.	—	51·9	47·0	4·9	·267	69	42·0	S.W.	34	Dark cumulus.	2	c^o	—	55·2	About 40 miles N.E. from Ushant.
21	noon	—	52·0	50·3	1·7	·343	88	48·6	W.	18	Nim., cum., cir-s.	7	c^2	—	59·1	Lat. 46deg. 50m. N. Long. 6deg. 50m. W.
22	noon	30·300	60·0	53·9	6·1	·342	66	48·5	N.	13	A little cumulus.	2	c_o	—	57·8	Cape Finisterre on port quarter.
24	4 to 8 p.m.	30·140 to 30·190	—	—	—	—	—	—	E.	About 34	Generally clear.	—	b or c^o	66·7	—	Entering Strait. Strong head sea.
24	8 p.m.	30·190	63·0	60·1	2·9	·477	83	57·7	E. by S.	18	Clear.	—	b^2	—	66·0	In the Strait.
														Range, 15·9	Range, 10·8	

* Barometer reduced to 32 deg. F., and sea level always.

Remarks.—Sea-surface temperature increased 4 degs. during the passage of the Bay of Biscay, where passing showers and counter-trades from W.S.W. were experienced. No marked fluctuations of atmospheric pressure, but it steadily gave way on approaching the African mainland. Highest value by Moffat's ozone tests, pinned inside the thermometer screen, 5.2 (scale 0 to 10), for periods of four and twelve hours; less than values obtained in the Moorlands of Staffordshire and Highlands of Scotland for similar periods of exposure.

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Oct.																
24	10.30 p.m.	30·184	*62·5	59·9	2·6	·477	84	57·7	E.	18	Generally clear.	0	b	—	—	In Strait of Gibraltar.
24-25	Midnight.	30·184	62·0	59·7	2·3	·478	86	57·7	E.	18	Clear.	0	b.w[2]	—	61·6	About 44 miles east by south from Gibraltar.
25	During 8 hours ending 8 a.m.	—	—	—	—	—	—	—	E. by S.	20	Generally clear.	0	b	61·0	—	Estimated at 90 miles east from Gibraltar. Colour of water, deep inky blue.
26	2 a.m.	30·053	*66·9	63·5	3·4	·534	81	60·8	E.	23	Generally clear.	—	—	—	—	About 20 miles N.E. by E. from Cape Tennez.
26	Noon.	30·104	72·0	65·0	7·0	·514	65	59·7	E.	18	Light cirriforms.	3	c	—	69·9	Lat. 37deg. 02m. N. Long. 4deg. 07m. E. Water deep blue.
26	Noon to 4 p.m.	30·104	—	—	—	—	—	—	E.	18	Generally clear.	—	—	73·4	—	About 70 miles E.N.E. from Algiers.
27	4 p.m.	30·113	66·7	60·4	6·3	·439	67	55·4	E.N.E.	13	Cumulus and cumuli.	4	c	—	70·2	Cape Bon nearly abeam, 2½ miles distant. Water very deep blue.
		Range, 0·131												Range, 12·4	Range, 8·6	

* Hygrometric values interpolated.

NOTES.—Pressure remained generally steady—the curve gently rising between 5 a.m. and 9 a.m. (owing to chilly morning air and accumulation of vapour), and dipping between 10 a.m. and 6 p.m. (due to decrease of evaporation and expansion of air by afternoon heat). Easterly winds travelling round the northern edge of the cyclonic area of Sahara entirely obtained, accompanied with intense "visibility" and terrestrial refraction. Ozone tints ranged between 3·5 and 5·6 for four and eight hours respectively.

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to be compared therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and Remarks.
Oct. 29	—	—	—	—	—	—	—	—	E. to N.E. then veering S.	—	Ugly cumulus nimbus, and cirro-status.	About 6	u c2	60·5	—	Within 300 miles E.S.E. from Malta, under conditions of barometric depression, accompanied by rain-squalls and thunderstorm.
29	8 a.m.	Steady at 29·963	66·8	63·9	2·9	·550	84	61·6	N.E.	13	Cirri forms & cumulus.	7	c2	—	71·3	About 150 miles E.S.E. from Malta; also about 8 p.m.
29	Noon.	Steady at 29·947	69·0	64·2	4·8	·524	74	60·5	S.S.E.	13	Filmy cirriforms, cumulus.	6	c	—	72·4	Lat. 34deg. 55m. N., long. 18deg. 52m. E. Water deep blue.
30	10 p.m.	Steady at 30·140	*70·6	*64·8	5·8	·526	70	60·4	S.Ely	11	Generally clear.	0	b	—	—	Lat. 33deg. 0m. N., long. 26deg. 20m. E. Dewy night; lightning on western horizon.
31	Noon.	30·102 Range, 0·193	75·0	65·3	9·7	·488	56	58·3	Var. airs.	4	Cumulus types.	5	c	76·8 Range, 16·3	76·9 Range, 5·6	Lat. 32deg. 15m. N., long. 29deg. 8m. E. Water deep blue. N.B.—Max. air temp. occurred in forenoon.

Hygrometric values interpolated.

NOTES.—With the exception of a slight cyclonic depression between the 28th and 30th, the barographic curve was steady. Thunder, lightning, and heavy rain-squalls occurred in front of the disturbance, with the usual south-easterly winds on the N.E. side. No high value for ozone was recorded.

METEOROLOGICAL SYNOPSIS (SUEZ TO ADEN).

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type).

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew-point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks
Nov., 1883.																
3	4 p.m.	29·916	74·1	62·7	11·4	·426	51	54·4	Wly.	25	Cumulus.	7	c	70·1	75·3	About 50 miles south from Suez. Colour of water white-slate. Sea rather rough.
3	8 p.m.	29·984	74·0	62·5	11·5	·422	50	54·1	Wly.	18	Loose cumulus.	4	c	—	—	About 88 miles from Suez. Air warm and soft.
4	10 a.m.	30·065	*74·3	63·7	10·6	·451	53	56·0	N.Wly.	About 18	—	—	—	—	—	Lat. about 23deg. 20m. N.
6	4 p.m.	29·901	84·8	77·1	7·7	·789	65	72·1	Calm.	3	Cumulus, cirro-cumulus.	4	c	—	88·9	Lat. 17deg. 45m. N. Long. 40deg. 0m. E., approximate. Heavy dew at night.
6	about 6 p.m.	29·921	*83·9	77·3	6·6	·810	69	73·0	Calm.	3	—	—	—	87·6	—	Lat. 17deg. 30m. N. Long. 40deg. 30m. E., approximate. Lightning shortly to W.N.W.
7	4.15 a.m.	29·926	80·0	78·5	1·5	·942	93	77·5	Sthly.	13	—	—	—	—	80·6	Coming up to Jebel Teir.
		Range, 0·164												Range, 17.5	Range, 13·6	

* Hygrometric values interpolated.

NOTES.—Strong rainbands were frequently observed in the spectroscope at 7 deg. above the horizon during the Red Sea passage. As in the earlier part of the voyage, I obtained no high values for ozone, using Moffats' tests, 5·0, on a scale of 0 to 10, being never exceeded.

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, scale 0 to 10.	Weather by Beaufort notation.	Air temperature.	Water temperature.	Position and remarks.
Nov 1883																
8	4 p.m.	30·001	82·9	76·9	6·0	·809	72	72·8	E. by N.	18	Cumulus cumuli.	2	c[0]	—	83·2	About 12 miles from Aden. Sea slight. Water a deep bluish slate colour.
9	8 a.m.	30·028	79·4	75·2	4·2	·795	79	72·3	E. by N.	18	Types of cumulus.	5	c	—	81·1	About 187 miles east from Aden. Sea a deep slate-blue. North-east monsoon setting in.
10	8 a.m.	30·005	76·8	73·9	2·9	·783	85	71·8	N.E.by E.	13	Cumulus cumuli, loose cumulus.	4	c	—	78·2	Off the Island of Abd-al-Kuri. Colour of water a strong blue, with tint of green.
10	4 p.m.	29·903	82·7	75·8	6·9	·763	68	71·3	E. by N.	8	Cumulus cumuli, loose cumulus.	3	c	*85·2	—	About 30 miles south from Socotra.
15	4 p.m.	29·831	79·8	76·7	3·1	·858	85	74·6	Calm.	3	Cumulus, cumulo-stratus, cirro-cumulus	6	c	—	81·9	Lat. 7deg. 43m. N., long. 77deg. 3m. E. About 40 miles S.W. from Cape Comorin. At anchor off Colombo.
		Range, 0·197												75·1 Range, 10·1	Range, 5·0	

* Also on the 15th, read at noon.

Arrived at Colombo November 16th. While at Colombo, between 7 a.m., November 16th, and 1 a.m., 17th, the barometer merely presented the phenomenon of the ordinary diurnal tropical curve. Temperature ranged between 87·8 and 73·5, and the value for ozone was 3·0.

METEOROLOGICAL SYNOPSIS.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type).

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, 0 to 10.	Weather by Beaufort notation.	Air temperature.* †	Water temperature.	Position and remarks.
Nov., 1883.																Sea very smooth. Colour of water, deep blue. Came across floating pumice. Lat. 5deg. 50m. S.; long. 89deg. 45m. E., approximate.
20	4 p.m.	**29·812**	81·5	73·0	**8·5**	·668	62	67·3	S.E. by E.	13	Cumulus, cum. stratus, cirro-cumulus	9	c²	**83·8**	**82·9**	
																Ship pitching heavily. Colour of water, deep blue. Lat. 13 deg. 46m. S. Long. 94deg. 50m. E.
23	Noon.	29·862	76·0	75·3	**0·7**	·863	96	74·8	S.E. by E.	32	Cirrus and cirro-stratus, with cum. and loose cum. beneath.	7	c	—	77·3	
																Lat. 22deg. 40m. S.; long. 95deg. 15m. E., approximate. Ship pitching; wild squally night.
25	8 p.m.	30·103	68·8	66·4	2·4	·606	86	64·5	E.S.E.	28	Spreading and detached cumulus.	7	c	**68·8**	**71·2**	
																Conditions of weather generally same as above. Lat. 23deg. 5m. S.; long. 95deg. 17m. E., approximate.
25	10 p.m.	**30·128**	—	—	—	—	—	—	E.S.E.	28	—	—	—	—	—	
		Range. 0·316												Range, 15·0	Range, 11·7	

* As observed, self-registering thermometers had to be removed.

† Within last four hours.

Meteorological Synopsis.

(N.B.—The synoptic extremes are in large type; elements to compare therewith in small type.)

Date.	Hour.	Bar. fully reduced.	Dry bulb.	Wet bulb.	Difference.	Vapour tension.	Relative humidity, per cent.	Dew point.	Wind.	Miles per hour	Cloud.	Amt. of cloud, 0 to 10.	Weather by Beaufort notation.	Air temperature.*	Water temperature.	Position and remarks.
1883.																
Nov. 26	8 a.m.	30·184	69·2	61·0	8·2	·427	59	54·6	E.S.E.	28	—	—	q	69·2	—	Weather squally and rainy. Lat. 24 deg. 40m. S.; long. 95deg. 40m. E., approximate.
Nov. 26	Noon.	30·153	67·7	62·0	5·7	·474	69	57·5	E.S.E.	23	Compact and fleecy cumulus.	8	c	—	68·1	Lat. 25deg. 15m. S. Long. 95deg. 47 m. E.
Nov. 27	10·15 a.m.	30·416	—	—	—	—	—	—	S.E. by S.	23	—	—	—	—	—	Lat. 28deg. 40m. S.; long. 97deg. 45m. E., approximate.
Dec. 1	4·15 p.m.	29·991	63·2	61·1	2·1	·536	88	59·3	E. by S.	34	Forms of cirrus cumulus and stratus.	3	c	—	58·9	Lat. 35deg. 45m. S.; long. 116deg. 0m. E., approximate.
Dec. 4	About 8 a.m.	29·709	59·0	59·0	0·0	·500	100	59·0	N.	13	Pallium of fog.†	10	—	59·0	60·3	About 150 miles E.S.E. from Recherche Archipelago.
Dec. 4	11 p.m.	29·467	—	—	—	—	—	—	N.E.	18	—	—	—	—	—	During thunderstorm in Australian Bight.
		Range, 0 949												Range, 10·2	Range, 9·2	

* As observed.

† Absolute saturation and conditions of fog observed also at other times in these latitudes.

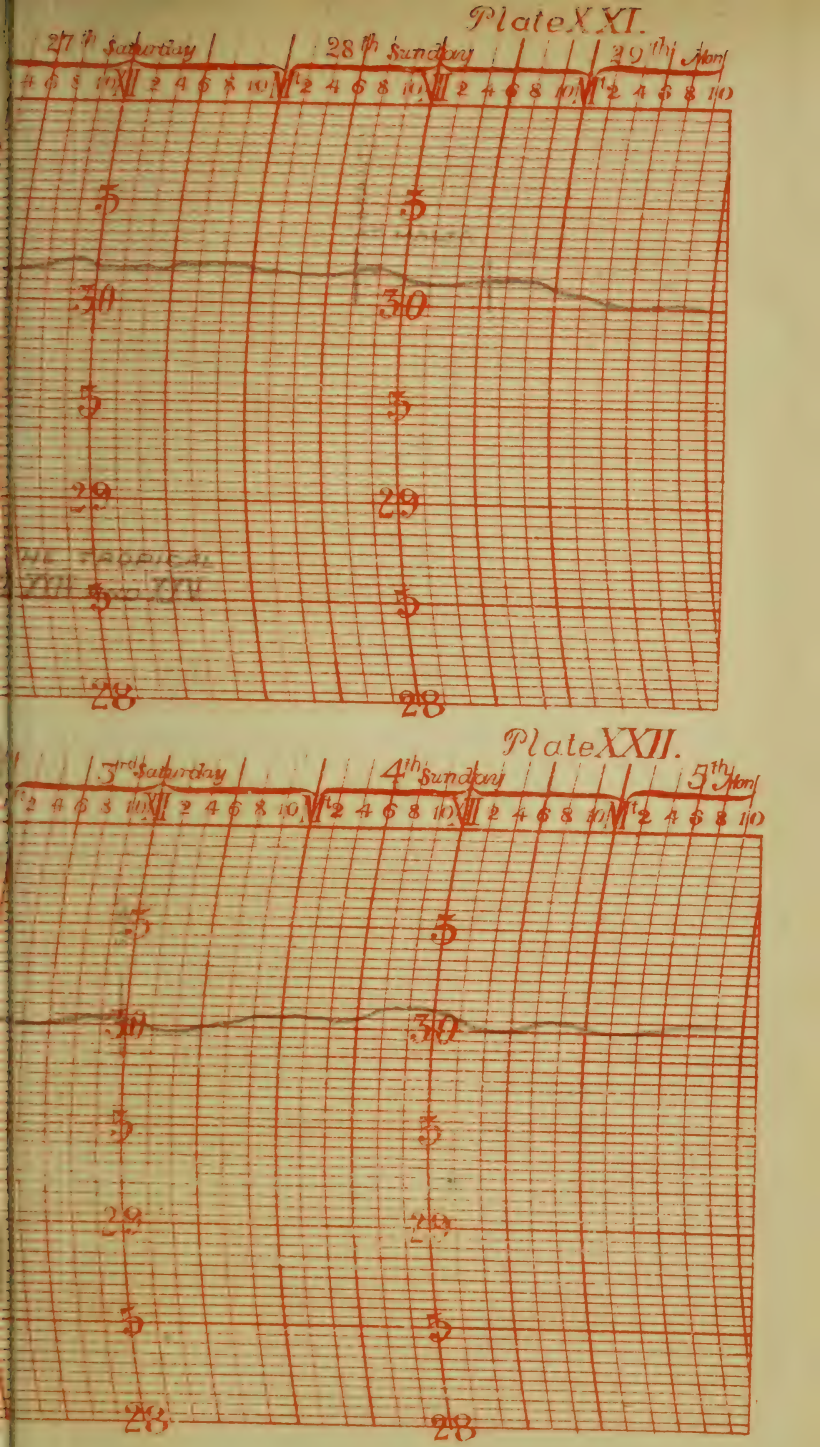


Plate XXI.
27th Saturday
28th Sunday
29th Mon
30
29
28
Plate XXII.
3rd Saturday
4th Sunday
5th Mon
30
29
28

Plate XI.

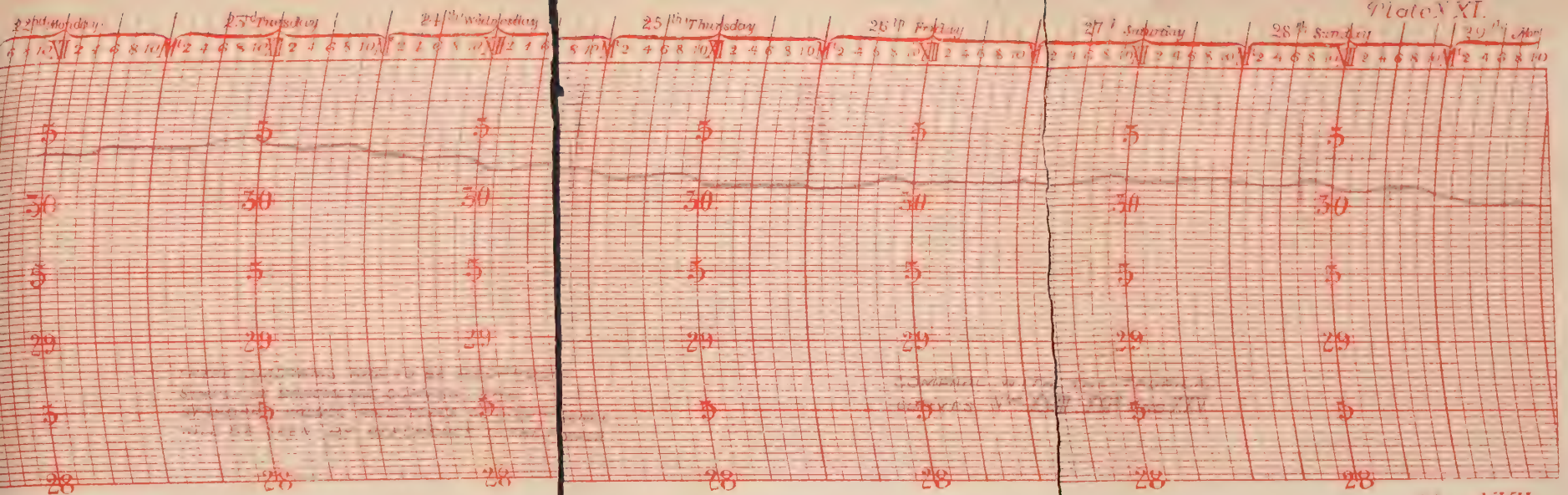
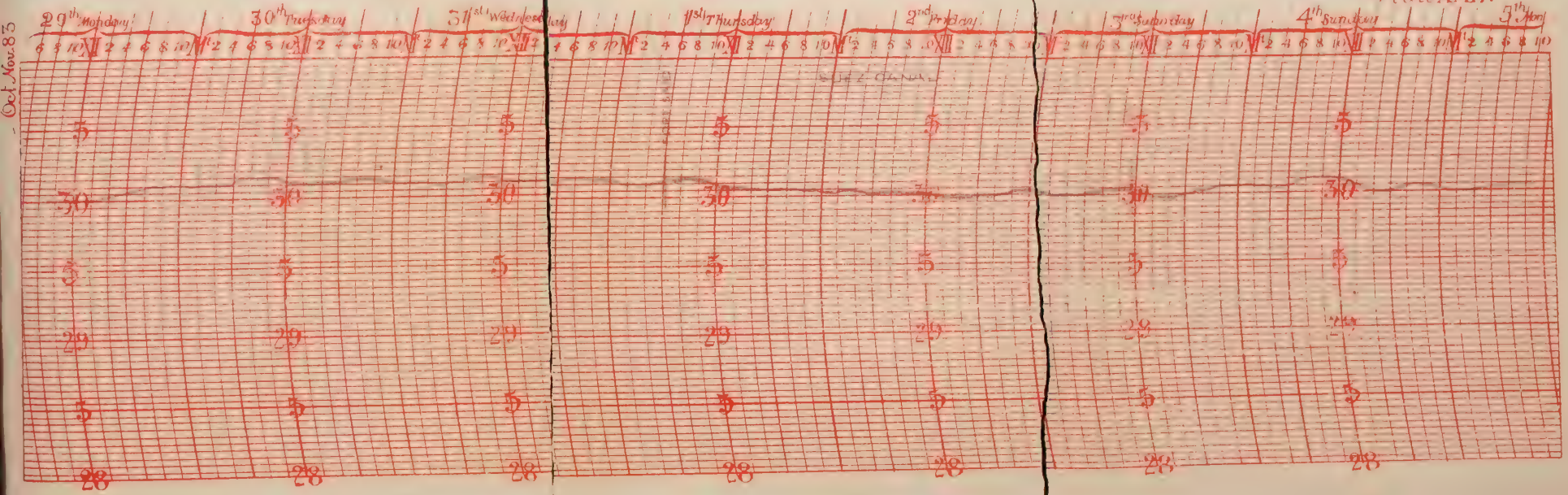


Plate XXII.



Oct. Nov. 83

Nov, 83.

5th Monday 6 4 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

6th Tuesday 6 4 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

7th Wednesday 6 4 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

30 5 29 5 28

30 5 29 5 28

30 5 29 5 28

Nov 1883

12th Monday 2 4 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

13th Tuesday 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

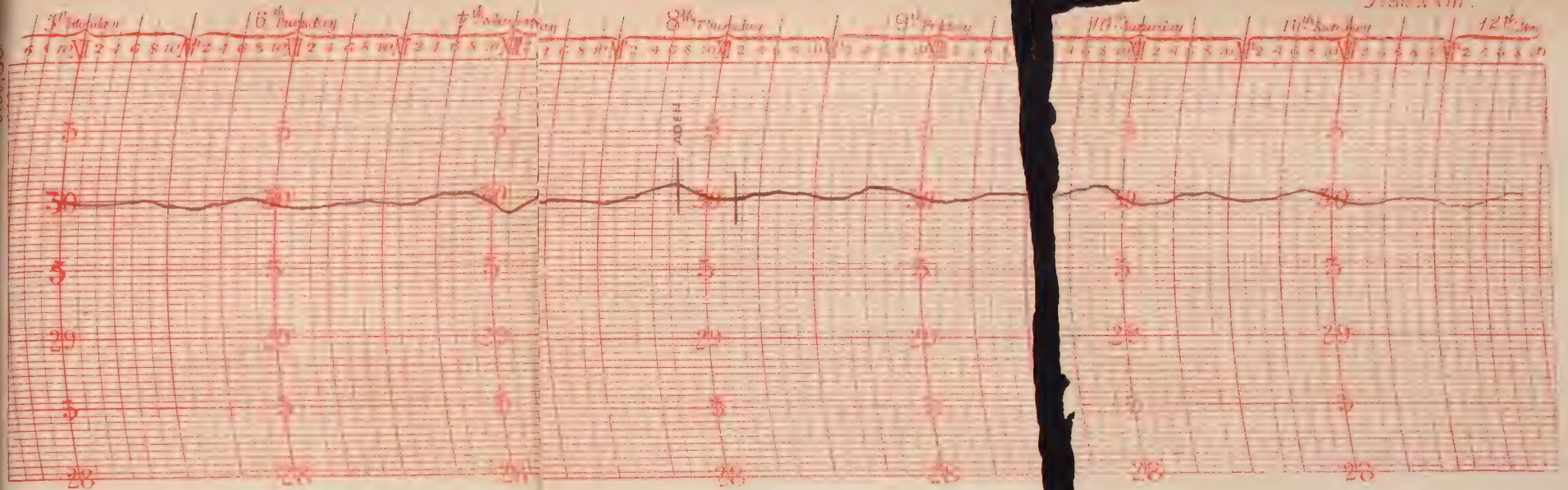
14th Wednesday 2 4 6 8 10 XII 2 4 6 8 10 M 2 4 6 8 10 XII 2

UNIFORM TROPICAL CU

30 5 29 5 28

30 5 29 5 28

30 5 29 5 28


ADEN

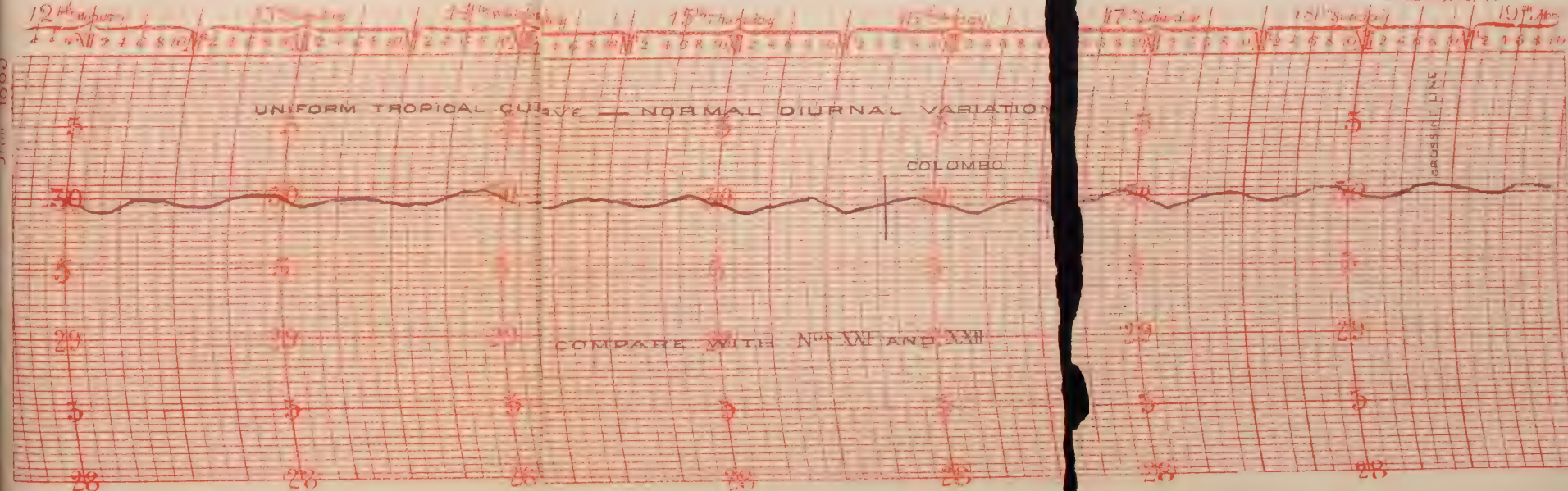

UNIFORM TROPICAL CUR
NORMAL DIURNAL VARIATION
COLOMBO
GRUSSOL LINE
COMPARE WITH Nos XXI AND XXII

Plate XXIII.

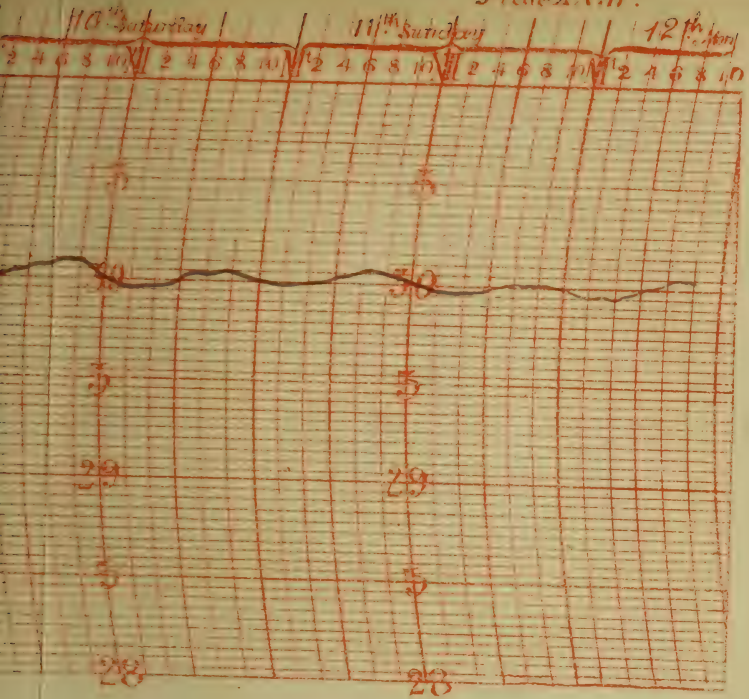
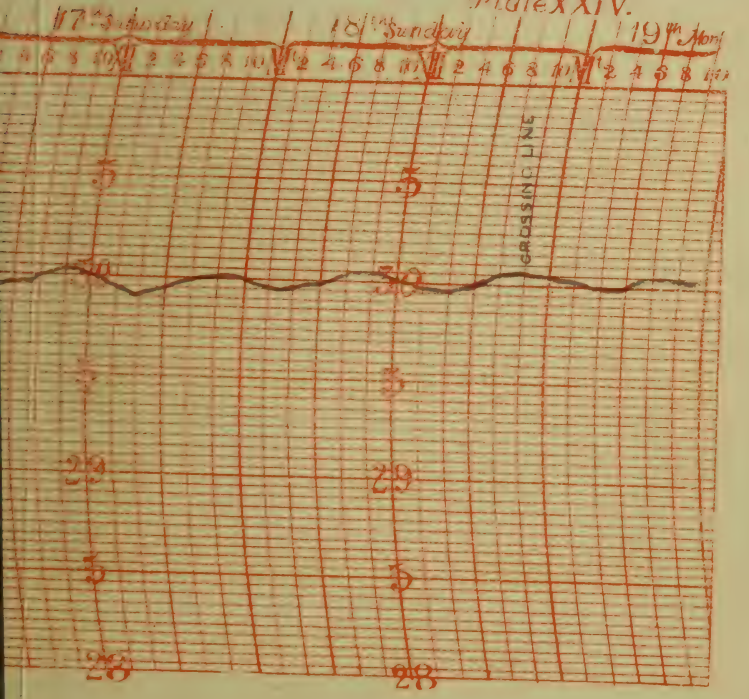


Plate XXIV.



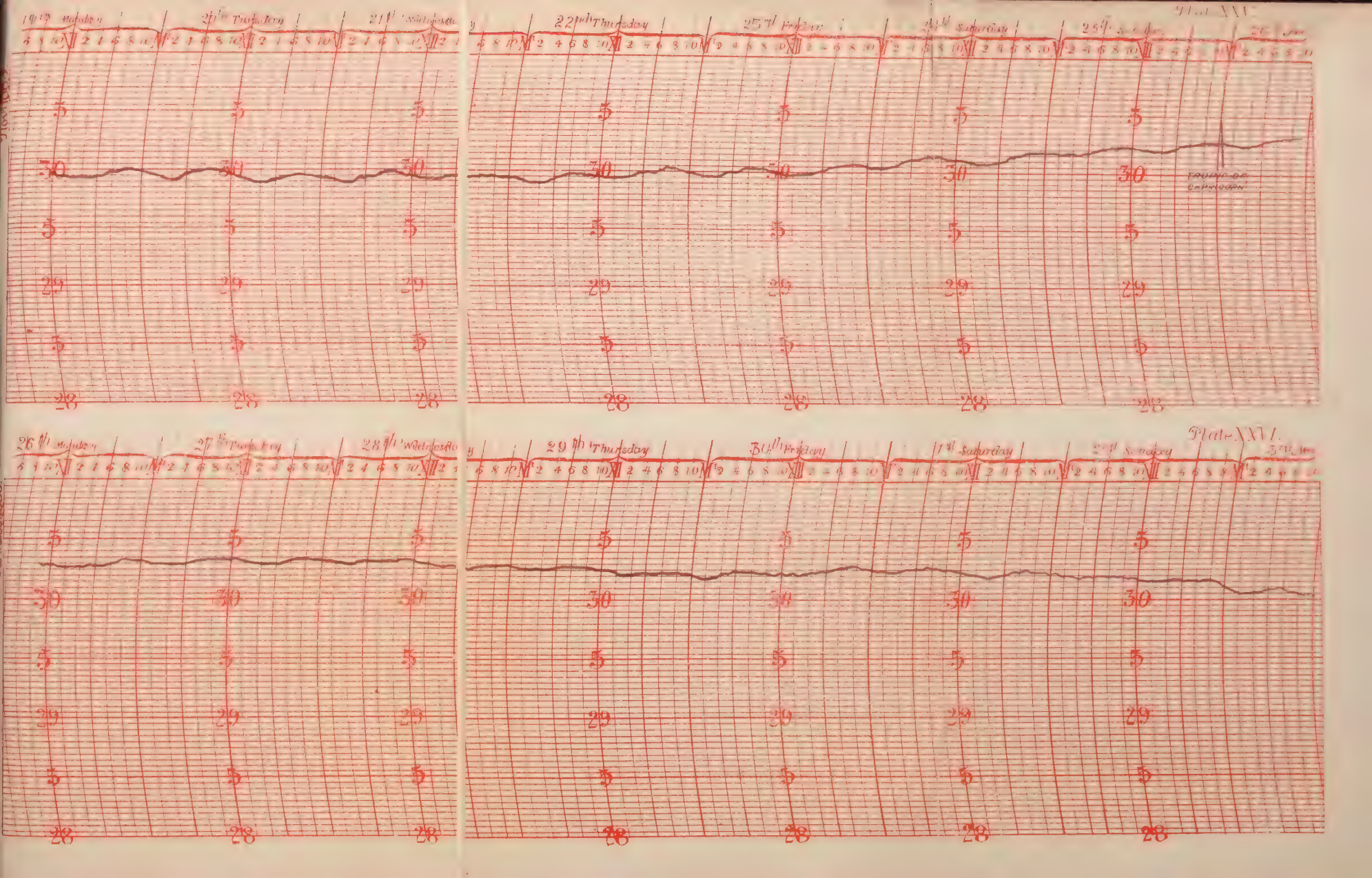


Plate XXV
Plate XXVI.
22nd Thursday
25th Friday
26th Monday
27th Tuesday
28th Wednesday
29th Thursday
30th Friday
1st Saturday
5
30
29
28

MISCELLANEA.

Plants Collected in the Vicinity of the Mulligan River by Mr. W. H. Cornish during his Survey Expedition in 1885; enumerated by Baron von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

Erysimum Blennodia, *F. v. M.*
Tribulus hystrix, *R. Brown.*
Zygophyllum Howittii, *F. v. M.*
Lavatera plebeja, *Sims.*
Sida corrugata, *Lindley.*
Sida rhombifolia, *Linné.* A variety with long-awned fruitlets, much like that illustrated by Cavanilles (Dissert. I., t. 12, fig. 2), but the leaves more like those of *S. virgata;* thinly velvety on both sides, and the flower-stalks much elongated. This particular plant was referred to by Bentham, as found on the Comet and Nicholson Rivers. A good distinguishing name would be *atherophora.*
Melhania incana, *Heyne.*
Owenia acidula, *F. v. M.*
Frankenia lævis, *Linné.* One of its numerous forms.
Claytonia Balonnensis, *F. v. M.*
Ptilotus obovatus, *F. v. M.*
Ptilotus alopecuroides, *F. v. M.*
Ptilotus helipteroides, *F. v. M.*
Rhagodia spinescens, *F. v. M.* The variety with deltoid leaves.
Alternanthera triandra, *Lamarck.*
Atriplex leptocarpum, *F. v. M.*
Kochia villosa, *Lindley.*
Chenolea bicornis, *F. v. M.*
Chenolea Cornishiana, *F. v. M.*
Chenolea quinquecuspis, *F. v. M.*
Enchylæna tomentosa, *R. Brown.*
Salsola kali, *Linné.* The variety with strobilaceous crowded fruits.
Mesembrianthemum æquilaterale, *Haworth.*
Codonocarpus cotinifolius, *F. v. M.*
Crotolaria linifolia, *Linné, fil.*
Crotolaria Cunninghami, *R. Brown.*
Crotolaria dissitiflora, *Bentham.*
Crotolaria Mitchelli, *Bentham.*
Psoralea patens, *Lindley.*
Trigonella suavissima, *Lindley.*

Indigofera hirsuta, *Linné.*

Ptychosema trifoliolatum, *F. v. M.* This remarkable plant has been recently obtained by Mr. H. Andrae at Pulpulla, in New South Wales. *Legume glabrous*, oblong-linear, flat, hardly more than one inch long; seeds generally eight to nine, roundish; funicle short; strophiole none. Should on discovery of the fruit of the typical *P. pusillum* it be found needful to separate the two species generically, then for *P. trifoliolatum* the name *Cornishia* may be chosen.

Sesbania aculeata, *Persoon.*

Swainsona microphylla, *A. Gray.*

Swainsona oligophylla, *F. v. M.*

Æschynomene Indica, *Linné.*

Glycine sericea, *Bentham.*

Bauhinia Leichhardti, *F. v. M.*

Acacia aneura, *F. v. M.*

Eucalyptus pachyphylla, *F. v. M.* The anthers occur roundish, so that this species could be transferred to the series of *Strongylantheræ.*

Eucalyptus terminalis, *F. v. M.*

Eucalyptus microtheca, *F. v. M.*

Annamannia multiflora, *Roxburgh.*

Haloragis Gossei, *F. v. M.*

Didiscus glaucifolius, *F. v. M.* Imperfect specimens with blue flowers, seemingly referable to this species. The normal form has been gathered on the Barcoo by the Rev. T. Flierl, and on the Paroo by Mrs. Spencer.

Santalum lanceolatum, *R. Brown.*

Grevillea juncifolia, *Hooker.*

Grevillea stenobotrya, *F. v. M.*

Spermacocce marginata, *Bentham.* A variety remarkable for the narrowness of its leaves and calyx lobes.

Minuria Candollei, *F. v. M.*

Calotis porphyroglossa, *F. v. M.*

Pterocaulon sphacelatus, *Bentham.*

Helipterum pterochætum, *Bentham.*

Helichrysum apiculatum, *DeCandolle.*

Helichrysum semicalvum, *F. v. M.* Referred by Bentham to the genus Leptorrhynchos, but best kept under Helichrysum. Concerning *L. linearis*, it may be noted that it constitutes merely a form of *L. squamatus*, but Bentham's plant of that name is *L. nitidulus*, and as such it is given already in my second report, p. 12 (1854). Mr. A. M. Howitt found it recently on Meriman's Creek. *L. pulchellus* has been gathered as far west as Fowler's Bay by Mrs. Richards. *L. tenuifolius* extends to Gippsland and to Lake Bonney.

Rutidosis helichrysoides, *DeCandolle.*
Myriocephalus Stuartii, *Bentham.*
Calocephalus platycephalus, *Bentham.*
Senecio Gregorii, *F. v. M.* Now known also from the Murrumbidgee and Lachlan River (*F. v. M.*), Mount Murchison (*Bonney*), Spencer's Gulf (*Lattorf*), Paroo (*L. Morton*), Alberga and Lake Eyre (*Giles*), Eyre's Creek (*Kayser*), Finke River (*R. Warburton*), Pidinga (*Mrs. Richards*), Oldea (*Tietkens*), Gascoyne River (*Hon. J. Forrest*).
Senecio lautus, *A. Richard.*
Isotoma petræa, *F. v. M.*
Brunonia australis, *Smith.*
Velleya connata, *F. v. M.*
Scævola ovalifolia, *R. Brown.*
Erythræa australis, *R. Brown.*
Cynanchum floribundum, *R. Brown.*
Ipomœa Muelleri, Bentham.
Evolvulus linifolius, *Linné.*
Nicotiana suaveolens, *Lehmann.*
Duboisia Hopwoodii, *F. v. M.* The famous Pituri bush, found also near Eucla by Mr. J. Oliver.
Mimulus gracilis, *R. Brown.*
Mimulus prostratus, *Bentham.*
Pollichia Zeilanica, *F. v. M.*
Mentha australis, *R. Brown.*
Teucrium racemosum, *R. Brown.*
Eremophila maculata, *F. v. M.*
Eremophila bignoniflora, *F. v. M.*
Eremophila Macdonnellii, *F. v. M.* A red-flowering variety.
Triraphis mollis, *R. Brown.*
Erianthus fulvus, *Kunth.*
Eragrostis concinna, *Stendel.*
Marsilea quadrifolia, *Linné.* The variety *hirsuta* as well as the form *erosa.*

Additional Lichens and Fungi of South Australia, collected by J. G. O. Tepper, F.L.S., 1880 to 1885.

These were remitted to Baron Sir Ferd. von Mueller, K.C.M.G., &c., the eminent Government Botanist of Victoria, who most courteously submitted them to European specialists of note for identification, and sent me the list of names, being addenda to previous contributions.

Lichens.

Cladonia squamata, *Hoffmann.* Coast of St. Vincent Gulf, 1883.
Cladonia capitellata, *Babington.* Kangaroo Island, 1884.

Parmelia revoluta, *Floerke*. Yorke's Peninsula.
Physcia stellaris, *Nylander*. Yorke's Peninsula, 1880.
" tribacnia, *Nylander*. Clarendon, 1882.
Thelaschistes chrysophthalmus, *Th. Fries*. Yorke's Peninsula, 1880.
Usnea barbata, *Acharius*. Yorke's Peninsula, 1880.
Ramalina geniculata, *Taylor*. Yorke's Peninsula, 1880.
" fraxinea, *Acharius*. Yorke's Peninsula, 1880.
" calicaris, *Acharius*. Yorke's Peninsula, 1880.
Lecidea enteroleuca, *Acharius*. Yorke's Peninsula, 1880.

FUNGI.

Peziza badia, *Persoon*. Clarendon, 1882.
" cochleata, *Bulliard*. Clarendon, 1882.
" fumerata, *Cooke*. Clarendon, 1882.
Agaricus cassiæcolor, *Berkeley*. Clarendon, 1882.
Polyporus pelliculosus, *Berkeley*. Clarendon, 1882.
The Fungi were named by Dr. Cooke, through Baron Sir F. von Mueller, May 31, 1886.

LICHENS NEW FOR SOUTH AUSTRALIA, EXAMINED BY DR. JEAN MUELLER.

Ramalina Eckloni, *Nylander*. Eucla (*Batt*).
" geniculata, *Taylor*. Eucla (*Batt*).
Parmelia hypoxantha. Eucla (*Batt*).
Pertusaria punctulata, *Duby*. Yorke's Peninsula (*Tepper*).

EXCERPT FROM THE THIRD AND FOURTH SUPPLEMENTS OF BARON VON MUELLER'S SYSTEMATIC CENSUS OF AUSTRALIAN VASCULAR PLANTS, GIVING THE SPECIES ADDITIONAL TO THE FLORA OF EXTRATROPIC SOUTH AUSTRALIA.

[Third Supplement.]

Tribulus macrocarpus, *F. v. M.* Towards the tropic near the Queensland Boundary (*Winnecke*).
Sida platycalyx, *F. v. M.* As above.
Sida lepida, *F. v. M.* As above.
Phyllanthus thesioides, *Bentham*. Finke River (*Rev. H. Kempe*).
Casuarina humilis, *Otto and Dietrich*. Eucla (*Batt*).
Dodonæa tenuifolia, *Lindley*. Near Barrier Ranges.
Bassia Cornishiana, *F. v. M.* Field River (*Cornish*).
Gomphrena lanata, *R. Brown*. Finke River (*Rev. H. Kempe*).
Pultenæa scabra, *R. Brown*. Kangaroo Island (*Tepper*).
Crotalaria Mitchelli, *Bentham* (*Tate*).
Ptychosema trifoliolatum, *F. v. M.* Near Barrier Ranges.
Neptunia monosperma, *F. v. M.* Finke River (*Rev. H. Kempe*).

Melaleuca quadrifaria, *F. v. M.* Eucla (*Batt*).
Acacia Whanii, *F. v. M.* Near Bordertown (*Winnecke*).
Acacia stipuligera, *F. v. M.* Subtropic region (*Rev. H. Kempe*).
Acacia gonophylla, *Bentham.* Near Eucla (*Batt*),
Hydrocotyle pterocarpa, *F. v. M.* Near the Glenelg River.
Spermacocce marginata, *Bentham.* Near the tropic of Capricorn towards the Queensland boundary (*Winnecke*).
Pluchea tetrandra, *F. v. M.* Near MacDonnell Ranges (*Rev. H. Kempe*).
Gnaphalium Indicum, *Linné.* As above.
Calocephalus Dittrichii, *F. v. M.* Charlotte Waters (*Dittrich*).
Calogyne Bernardiana, *F. v. M.* Near the Finke River (*Rev. H. Kempe*).
Goodenia Strangfordi, *F. v. M.* As above.
Cuscuta Tasmanica, *Engelmann.* Near Bordertown.
Peplidium humifusum, *Delile.* Finke River (*Kempe*).
Utricularia lateriflora, *R. Brown.* Near the Glenelg River.
Eremophila denticulata, *F. v. M.* Near Eucla (*Batt*).
Acianthus caudatus, *R. Brown.* Kangaroo Island (*Tepper*).
Thelymitra luteo-ciliata, *Fitzgerald.* Near Mount Lofty (*Fitzgerald*).
Crinum angustifolium, *R. Brown.* Near MacDonnell Ranges.
Triodia Mitchelli, *Bentham.* Near Barrier Ranges.

[Fourth Supplement.]

Comesperma silvestre, *Lindley.* Near Barrier Ranges.
Stackhousia muricata, *Lindley.* Gosse's Range (*Rev. J. Schwartz*).
Portulaca australis, *Endlisher.* In the subtropic region towards the Queensland boundary (*Lieut. Dittrich*).
Nematophyllum Hookeri, *F. v. M.* As above.
Æschynomene Indica, *Linne.* As above.
Acacia coriacea, *DeCandolle.* Cooper's Creek (*Rev. J. Flierl*).
Lhotzkya Smeatoniana, *F. v. M.* Kangaroo Island (*Tepper*).
Eucalyptus Oldfieldii, *F. v. M.* Near Finke River (*Rev. H. Kempe*).
Hydrocotyle comosa, *F. v. M.* Kangaroo Island (*Tepper*).
Hydrocotyle diantha, *De Condolle.* Kangaroo Island (*Tepper*).
Actinotus Schwartzii, *F. v. M.* MacDonnell Ranges (*Rev. J. Schwartz*).
Hakea chordophylla, *F. v. M.* Subtropic region near Queensland boundary (*Lieut. Dittrich*).
Hakea nitida, *R. Br.* Eucla (*Batt*).
Podolepis rhytidochlamys, *F. v. M.* Near the Barrier Ranges.
Helipterum læve, *Bentham.* Near the Barrier Ranges.
Ceratogyne obionoides, *Turczaninow.* Near the Barrier Ranges.

Erechtites picridioides, *Turcz.* Murray River (*F. v. M.*)
Candollea Tepperiana, *F. v. M.* Kangaroo Island (*Tepper*).
Catosperma Muelleri, *Bentham.* Near MacDonnell Ranges (*Lieut. Dittrich*).
Styphelia hirsuta, *F. v. M.* Kangaroo Island (*Tepper*).
Logania stenophlla, *F. v. M.* Close to Eucla (*G. R. Turner*).
Templetonia Muelleri, *Bentham.* On the Western Borders of Victoria.

ADDITIONS TO THE ENTOMOLOGICAL FAUNA OF SOUTH AUSTRALIA.

I. Revision of Australian Lepidoptera. Part 1. By E. Meyrick, Proc. Lin. Soc., N.S. Wales, second series, vol. I., part 3, p. 687, *et seq.*

FAMILY ARCTIADÆ.

7. Scoliacma bicolor, *Boisd.* (Lithosia); L. rubratra, *Tepper.*
18. Brunia replana, *Lw.*
20. Lithosia bicosta, *Walk.*
44. Sorocostia semograpta, *Meyrick.*
47. Sorocostia vetustella, *Walk.*
50. Sorocostia cycota, *Meyrick.*
54. Nola lugens, *Walk.*
69. Hestiarcha pyrrhopa, *Meyrick.*
72. Thallarcha albicollis, *Feld.*
95. Areas marginata, *Don.*
97. Deiopeia pulchella, *L.*

FAMILY HYPSIDÆ.

98. Nyctemera amica, *White.*

FAMILY ZYGÆNIDÆ.

146. Hestiochora tricolor, *Walk.*
148. Procris dolens, *Walk.*
155. Procris viridipulverulenta, *Guér.*
156. Procris cuprea, *Walk.*

II. The Genus Liparetrus. By. W. Macleay. P.L. Soc., op. cit., p. 807, et seq.

1. L. phænicopterus, *Germ.;* 5. L. Germari, *Macleay;* 7. L. villosicollis, *Macleay;* 10. L. nigrinus, *Germ.;* 11. L. ater, *Macleay;* 14. L. comatus, *Macl.;* 15. L. nitidipennis, *Macl.;* 20. L. Kreusleræ, *Macl.;* 21. L. atratus, *Burm.;* 22. L. iridipennis, *Germ.;* 27. L. bituberculatus, *Macl.;* 31. L. discipennis, *Guér.;* 35. L. canescens, *Macl.;* 45. L. rugosus, *Macl.;* 46. L. collaris, *Macl.;* 48. L. criniger, *Macl.;* 49. L. salebrosus, *Macl.;* 67. L. rotundipennis,

Macl.; 68. L. convexior, *Macl.;* 69. L. picipennis, *Germ.;* 70. L. obscurus, *Macl.;* 71. L. nitidior, *Macl.;* 74. L. vestitus, *Blanch.;* 75. L. nudipennis, *Germ.;* 76. L. squamiger, *Macl.;* 79. L. abnormalis, *Macl.;* 80. L. simillimus, *Macl.;* 81. L. Kennedyi, *Macl.;* 95. L. ordinatus, *Macl.*

III. A Revision of the Australian Staphylinidæ. Part II. By H. Sidney Olliff. P.L.S. op. cit., p. 887, et seq.

97. Conosoma phoxum, *Olliff;* 98. C. ambiguum, *Olliff;* 100. C. eximium, *Olliff.*

R.T.

New Australian Freshwater Entomostraca, by Professor G. S. Brady, Proc. Zool. Soc., London, Feb. 2, 1886.

The paper is prefaced by a list of all the Australian freshwater Entomostraca which have been described. The list gives the names and references of eight Phyllopods, nineteen of Cladocera, five of Copepoda, and fifteen of Ostracoda.

The species now described and figured are of Phyllopoda four and of Ostracoda seven, whilst four previously described are now illustrated for the first time.

The South Australian species were collected by Professor R. Tate, and have been named as follows:—*Limnetis Tatei*, Rivoli Bay; *Estheria lutraria*, Cooper Creek, at Innaminka; *Estheria Packardi*, Lake Bonney, River Murray; also Fowler's Bay; *Eulimnadia Rivolensis*, Rivoli Bay; *Cypris Tatei*, Adelaide; *Cypris mytiloides*, Kangaroo Island; *Chlamydotheca australis*, Penola.

Lepidurus viridulus, Tate, Port Creek, is figured.

Remarks on an Unusual Development of a Low Vegetable Organism.

Whilst passing between the city and North Adelaide on the morning of Friday, October 1st, 1886, I observed that the asphalt pavement presented a somewhat peculiar appearance. The weather was warm and calm, and a steady rain had been falling for about two hours. The wet asphalt was thickly dotted with slimy patches of a brownish colour, ranging in size from minute points to the circumference of a dinner plate. A little of the glary substance was gathered, and having been mixed with chloral in a phial, it was at once apparent that the colour of the mass was the result of a large number of small cellular bodies of a brownish tinge, which found support in the otherwise colourless slime. Under the microscope the cells

were shown to be an elongated-oval in shape, and with the exception of a very thin film of transparent substance bordering the periphery, the cell was filled with a brown granular mass. The cells were arranged end to end in a somewhat peculiar manner. At first sight the arrangement seemed to be that of a long spiral, but on closer inspection it was recognised that the circle of the spiral was not made complete, but that the line of cells just before completing the circle, at each turn, returned upon itself, so that on one side of the column the spiral looked perfect, but on the opposite side there was a slit extending the whole length of the column, bordered on either side by the rounded loops and intervening open spaces caused by the line of cells returning upon itself instead of completing the circuit. I believe each cell to have been disconnected from the others in the line of growth, although the majority seemed to be just at the touching point. I possessed no means of identifying this curious organism (if already known to science), but judge it may be one of the unicellular confervæ. The weather for some time previously had been very dry. Rain commenced about 6 a.m., and by 8 a.m. the confervoid (?) spores had attained an enormous development. The rain ceasing shortly afterwards, and the sun being warm, the pavement quickly dried, and the slimy patches were left as only dirty stains. The morning following was also wet, but the lowly organisms manifested but a very feeble vitality, and all traces of them quickly passed away. My observations did not extend beyond the distance covered from Government House to the Children's Hospital (about three-quarters of a mile), and cannot say whether they were present in the city or beyond the point in North Adelaide to which I traced them. Their distribution over this length was moderately even, but around the walls and gateposts of the Children's Hospital the patches were unusually large. The warm, humid conditions of the morning were no doubt specially favourable for the rapid increase of the species in question, but the sudden appearance of the form in such incalculable numbers, where their presence had never been suspected, is a somewhat curious phenomenon.

Walter Howchin.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia,

FOR 1885-86.

ORDINARY MEETING, NOVEMBER 10, 1885.

H. C. MAIS, M.I.C.E., in the chair.

BALLOT.—T. S. Reed was elected a Fellow.

W. L. CLELAND, M.B., read some notes drawing attention to the existence of polished rock-surfaces on the top of Caroona Hill, Lake Eyre.

H. T. WHITTELL, M.D., drew attention to and described a telescopic eye-piece for the microscope to correct imperfections in the illumination of objects.

ORDINARY MEETING, DECEMBER 1, 1885.

H. C. MAIS, M.I.C.E., in the chair.

BALLOT.—J. T. Mitchell, M.D., was elected a Fellow.

Paper by Mr. R. B. LUCAS upon "The British Standards of Weights and Measures."

ORDINARY MEETING, FEBRUARY 2, 1886.

H. C. MAIS, M.I.C.E., in the chair.

Mr. J. G. O. Tepper was transferred to the list of Fellows from the list of Corresponding Members.

J. G. O. TEPPER, F.L.S., exhibited a number of insects and insect-habitations. Also preparations of the codlin moth and its larva, found at Unley.

FRAZER S. CRAWFORD reported that he had found a species of *Tortrix*, which had attacked some apple trees near Port Adelaide. The larva was about an inch and a-half long, but was marked differently from that of the codlin moth, by having spots of an ovoid form on the sides.

W. ERNEST COOKE, B.A., read a paper entitled "Notes on the Planet 'Jupiter.'"

Ordinary Meeting, March 2, 1886.

W. Howchin, F.G.S., in the chair.

Ballot.—A. Zietz and D. Fleming were elected Fellows.

Clement L. Wragge, F.R.G.S., read "Scientific Results of the Voyage of the S.S. Maranoa."

Ordinary Meeting, April 6, 1886.

W. Howchin, F.G.S., in the chair.

Ballot.—W. B. Poole and James L. Scott were elected Fellows.

J. G. O. Tepper, F.L.S., exhibited a number of *Mantidæ* and *Phasmidæ*. Also a species of *Acantholophus* found on *Xanthorrhœa Tatei*, Kangaroo Island. Also a species of weevil (*Chrysolophus*), black with a white line. Also the core, sections, resin, and leaf-basis of *Xanthorrhœa Tatei* from Kangaroo Island.

Prof. Rennie read a paper upon "Poisoning by Tinned Foods."

Ordinary Meeting, May 4, 1886.

W. Rutt, C.E., in the chair.

Ballot.—Prof. Bragg was elected a Fellow, and the Rev. C. G. Nicholay a Corresponding Member.

A. Zietz showed a series of fishes belonging to South Australian waters.

F. A. Pulleine showed specimens of *Migerlia Williamshousii* and *Limopsis Tenison-Woodsii* from Encounter Bay.

J. G. O. Tepper, F.L.S., read a paper on "Aerial Boats; suggestions as to the principles of construction, and the obstacles to be surmounted."

Ordinary Meeting, June 1, 1886.

W. Howchin, F.G.S., in the chair.

Frazer S. Crawford showed some olives from near the Adelaide Gaol which had been attacked by *Aspidiotus Nerii*.

He also corrected an error made by the Hon. P. L. Van der Byl, of Cape Colony, in giving evidence before the Commission on Vegetable Products in Melbourne, in which he stated that *Saria Purchasii* had been seen in South Australia on the *Acacia armata*. The coccus found upon these plants was in reality yet undetermined, but he would provisionally name it *Erinum globosum*. *Saria Purchasii* was not common now, although abundant at the Cape.

A. Zietz exhibited a number of lizards of one species, but varying very much in colours and markings.

R. B. Lucas read a paper upon "Photometry," with some illustrations.

Ordinary Meeting, July 6, 1886.

H. C. Mais, M.I.C.E., in the chair.

Ballot.—John Wilson, F.E.I.P., was elected a Fellow.

A. Zietz showed specimens of *Trachinina*, common in the River Murray, and many creeks along the coast.

J. G. O. Tepper, F.L.S., read "Notes on some S.A. Trogidæ."

J. G. O. Tepper, F.L.S., exhibited a specimen of *Agyris amaryllis*, from Yorke Peninsula. Also some wood fossilised, obtained at Echunga from a depth of 60 feet.

G. Goyder, jun., read "Notes upon the Determination of Gold in Minute Quantities in Ores."

Walter Howchin, F.G.S., read the results of his investigations respecting the Foraminifera in the Tarkinnina and Mirrabuchinna bores.

Ordinary Meeting, August 3, 1886.

W. Howchin, F.G.S., in the chair.

Ballot.—A. P. Vaughan, M.B., was elected a Fellow.

H. T. Whittell, M.D., exhibited the results of some experiments he had made with vaccine lymph.

"Notes upon some New Fresh-water Entomostraca," by Prof. G. S. Brady, were read; illustrated by specimens obtained by Prof. R. Tate from Rivoli Bay, Cooper's Creek, Lake Bonney, Fowler's Bay, Kangaroo Island, and Penola.

Walter Howchin, F.G.S., showed a number of geological specimens from Crystal Brook, and pointed out the errors that miners might avoid if they only possessed a little more scientific knowledge of geology.

J. G. O. Tepper, F.L.S., brought forward some *Phasmidæ*—one probably new and undescribed.

A. Zietz showed a large collection of stone implements belonging to the Museum.

Ordinary Meeting, September 7, 1886.

Walter Howchin, F.G.S., in the chair.

Auditor—L. C. E. Gee was appointed Auditor of the Hon. Treasurer's accounts.

Thomas Parker, C.E., showed a sandstone with "ripple marks" from Betaloo.

J. G. O. Tepper, F.L.S., exhibited *Callitris Muelleri* from near the Murray Bridge.

A. Zietz showed a coccus (*Dorthesia*), also a specimen of *Lipidurus* and a species *Typhlops*.

J. Phillips forwarded geological specimens containing organic remains from near Hergott.

J. G. O. Tepper submitted lists and descriptions of newly-recorded plants from Kangaroo Island.

Baron F. von Mueller forwarded a paper on "*Corchorus Elderii*."

Gavin Scoular sent a paper descriptive of the "Physical Features and Geology of the District about Lake Eyre."

Annual Meeting, October 5, 1886.

H. C. Mais, C.E., in the chair.

Walter Howchin, F.G.S., showed samples of gelatinous masses, the result of confervoid growth, found by him on the asphalt pavement on King William road.

A note from Baron F. von Mueller respecting two additions to the flora of South Australia was read.

The annual report and balance-sheet were read and adopted.

Election of Officers.—Professor Rennie as President; Walter Howchin, F.G.S., and R. L. Mestayer, F.R.M.S., as Vice-Presidents; Walter Rutt, C.E., as Hon. Treasurer; W. L. Cleland, M.B., as Hon. Secretary; as members of Council, H. T. Whittell, M.D., Charles Todd, C.M.G., M.A., D. B. Adamson, J. W. Bussell, Prof. Bragg, J. Davies Thomas, M.D.

J. G. O. Tepper, F.L.S., suggested some alteration of rules, which were referred to the Council.

The President read his annual address (see p. 228).

Gavan Scoular forwarded a paper respecting Prof. Tate's objections regarding his paper on "Past Climatic Changes," &c.

Prof. Tate forwarded papers relating to the Palliobranchs, Lamellibranchs, Pteropods, and Scaphopods, with descriptions of some new Mollusca for South Australia.

Prof. Tate sent a description of *Caladenia cardiochila*, with a drawing by J. G. O. Tepper.

Prof. John Brazier forwarded a paper on the "Trochidæ of South Australia, with their Synonyms; part I."

E. Guest forwarded paper upon the "Geometrina Found Round Balhannah."

ANNUAL REPORT.

The Council has to report that the work of the Society has been successfully carried on during the past year. The following papers have been read or laid on the table:—"References to some Polished Rock Surfaces on Caroona Hill, Lake Gilles," by Dr. Cleland; "Description of a Telescopic Eyepiece for the Microscope," by Dr. Whittell; "The British Standards of Weights and Measures," by R. B. Lucas; "Notes of a large Sawfish found at Carnavan, W.A.," by Geo. Sarter; "Notes on some Insects and Insect Nests," by J. G. O. Tepper, F.L.S.; "Notes on a Species of Tortrix," by Frazer S. Crawford; "Observations on the Planet Jupiter," by W. Ernest Cooke, B.A.; "Scientific Results of the Voyage of s.s. Maranoa in the Indian Ocean," by Clement L. Wragge, F.R.G.S.; "Notes on the Mantidæ and Phasmidæ," by J. G. O. Tepper, F.L.S.; "Poisoning by Tinned Foods," by Professor Rennie; "On Aerial Boats," by J. G. O. Tepper, F.L.S.; "Photometry," by R. B. Lucas; "Notes on some South Australian Trogidæ," by J. G. O. Tepper, F.L.S.; "Notes on a New Butterfly for South Australia—*Ogyris amarillis*," by J. G. O. Tepper, F.L.S.; "On the Determination of Minute Quantities of Gold," by G. Goyder, jun.; "On some Foraminifera found in the Tarkininna and Mirrabuchinna Bores," by W. Howchin, F.G.S.; "On the Cultivation of Vaccine Lymph," by Dr. Whittell; "Some Fresh-water Entomostraca," by Prof. G. S. Brady; "Some Geological Notes on the neighbourhood of Crystal Brook," by W. Howchin, F.G.S.; "On some Phasmidæ," by J. G. O. Tepper, F.L.S.; "Some newly-recorded Species of the Flora of Kangaroo Island," by J. G. O. Tepper, F.L.S.; "Notes on *Corchorus Elderii*," by Baron F. v. Muller; "The Geology of the South and South-Western portion around Lake Eyre," by Gavin Scoular; "Notes on a New Species of *Caladenia*," by Professor Tate, F.G.S., &c.; "A Revision of the Recent Lamellibranch and Palliobranch Mollusca of South Australia," by Prof. Tate; "Notes on Past Climatic Changes in South Australia," by Gavin Scoular; "The Geometrina found near Balhannah," by E. Guest.

The exhibits have been numerous and varied, although nothing has been brought forward requiring special notice.

The membership of the Society consists of 117 Fellows, 11

Hon. Fellows, 14 Corresponding members, and two Associates. Several names, to the number of 16, have had to be removed from the roll on account of deaths and other causes. Nine new Fellows have been elected, and one Corresponding Member—the Rev. C. G. Nicholay, of Western Australia.

During the past year another Section of the Royal Society has been formed, namely, the Microscopical Section. It already includes many leading members of the Parent Society, as well as other independent workers; and under the guidance of its first chairman (Dr. Whittell) it has made considerable progress, and promises to be a valuable auxiliary.

The reports and balance-sheets of the two Sections appear satisfactory, and speak for themselves and of the particular work that they are respectively accomplishing.

It having been felt that the many valuable books of the Royal Society of South Australia were in their present position quite useless to the Fellows generally, your Council has proposed to the Board of Governors of the Public Library to allow a certain space for them in the Public Library, so that they may be easily accessible to the Fellows. This proposal has been favourably entertained by the Board, and it only requires the duplicates to be weeded out for the proposal to become an accomplished fact. It is hoped that this alteration may prove of benefit to the Fellows.

During the past year the Society has continued to receive a number of European and American and colonial periodicals on scientific matters generally. The Council has had a number of completed volumes bound, in order that they may be the better preserved. Amongst other books may be specially mentioned the receipt of additional numbers of the "Geological and Natural History Survey of Canada and the United States," "Report of the recent Volcanic Eruptions in New Zealand," "A Classified Index of Naturalised and Indigenous Plants of Queensland," and also a "Synopsis of the Queensland Flora," by F. M. Bailey; "Descriptions of Papuan Plants," by Baron F. v. Mueller; and by the same author, "On the Extratropical Plants of Australia."

A recommendation was made to the Board of Governors of the Museum by the Council, at the suggestion of the Field Naturalists' Section, with respect to the formation of a collection illustrative of the economic entomology of South Australia. The Board expressed its sense of the importance of the matter and willingness to co-operate as far as their limited space would allow, if the Fellows would furnish the material.

The Council has been communicated with in respect to the holding of a Centenary Science Association in Sydney in 1888, and has, on behalf of the Fellows, expressed its willingness to do

its best to represent South Australian science. The Council has also asked Mr. Russell, the Astronomer-Royal of Sydney and an Honorary Fellow of this Society, to represent this Society at the preliminary meetings. This he has very kindly promised to do, and the Society may congratulate itself on having secured so able a representative.

As in the previous year, the Council has authorised the preparation of a large number of plates illustrating some of the mollusca, and which are now being prepared under the valuable guidance of Prof. Tate. The results, as seen in the last volume of the Society's Proceedings, will cause the scientific world to look forward with a lively interest to a further instalment of Prof. Tate's scientific labours on this important branch of natural history.

PRESIDENT'S ADDRESS.

By H. C. Mais, M.I.C.E., read at the Annual Meeting, October 5, 1886.

I propose to touch upon various subjects with which most of us are familiar, and to take a retrospect of the advancement made during the past year. Confining myself more particularly to engineering achievements, the magnitude of the progress effected in engineering within recent times makes it impossible to present even an abridgment of the subject to the Society, involving as it would an exhaustive research into all the records of the various countries where the art is practised.

Engineering is, as Telford aptly describes it, "*the art of directing the great sources of power in nature for the use and convenience of man*," and you will at once perceive the vastness of the field in which the science of engineering is being practised. Amongst the foremost of engineering works of the day bridges and tunnels may be mentioned, and some very important bridges are in course of construction in England, America, and elsewhere. At the present time the most important structures now in progress in England are the Forth and Tay Bridges; in America, the Susquehanna River Bridge, the Henderson Bridge, and the John's River Bridge; in Canada, the Lachine Bridge; in India, the Sukkar Bridge across the Indus; and last, but not the least in magnitude, is the Hawkesbury Bridge in New South Wales. I do not propose to do more than briefly describe these structures, which are among the largest yet erected.

BRIDGES.

FORTH BRIDGE.

The Forth Bridge crosses the Forth at Queensferry, and was designed by Messrs. Fowler & Baker, C.E.s. The work was commenced by Messrs. Tancred & Arrol in January, 1883, and consists of two spans of 1,700 feet each, two of 675 feet, fourteen of 168 feet, and six of 50 feet. There is about a mile of main spans and half a-mile of viaduct approach. The clear headway is 150 feet above the water, and the top of the girder of the great cantilevers is 350 feet above high water. There will be 45,000 tons of steel used in superstructure, and 120,000 cubic yards of masonry in the piers. The contract price was £1,600,000. One peculiar feature in the design is that the bridge is constructed from its south abutment for a length of eleven spans of 147½ feet each as an ordinary double line of railway. The two lines of rails then diverge gradually, one on

each side of the centre line, by reverse forty-chain curves, for a distance equal to one span of 144 feet, two spans of 176 feet, and one of 176½ feet, at which point it reaches the Queensferry tower, and attains a width apart of 100 feet, forming two distinct lines of railway. It then runs parallel at this distance apart for the length of the two 1,700-feet spans for the four towers, and for the two spans between the towers of 165 feet each. The lines will gradually converge by reverse forty-chain curves, and regain the form of an ordinary double line of rails as far as the north abutment.

TAY BRIDGE.

The Tay Bridge is now being erected to supersede the bridge that collapsed during the gale in 1877. The new bridge was designed by Mr. W. H. Barlow, C.E., of London, and consists of 85 spans, being a total length of 10,515 feet, or nearly two miles. There are four brick arches and thirteen spans over navigation (eleven of them being 245 feet each and two of them 227 feet each), the two latter being 28 feet 9 inches deep. The piers are of wrought-iron, supported on iron cylinders sunk 20 feet into the river bed, and filled with concrete and brickwork. The height of the under members of the girders above high water is 77 feet. The contractors are Arrol & Co., of Glasgow, and the cost will be £700,000.

SUSQUEHANNA BRIDGE.

The Susquehanna Bridge is on the Baltimore and Ohio River, and is 6,315 feet long, having four spans of 480 feet, and one span of 520 feet.

HENDERSON BRIDGE.

The Henderson Bridge is also across the Ohio River, in Kentucky, U.S.A., is 3,200 feet long, with one channel span of 725 feet; the remaining spans are 250 feet each. It is 103½ feet above low water, and 57 feet above high water. The approach is by trestle work three miles in length, and the cost has been £372,000.

ST. JOHN'S BRIDGE.

The St. John's Bridge is a cantilever bridge 447 feet between the piers. It is built across the river before it enters the Bay of Fundy, and at a point where it is contracted between two rocky ledges to a width of about 500 feet. The tide rises and falls about 22 feet, producing violent currents, so that a cantilever bridge was the most feasible structure. The rail level is 75 feet above tide. The erection of this bridge occupied 90 days, and the structure is capable of carrying a moving load of one and a quarter tons, and a wind pressure of 40 pounds per superficial foot. It was designed by Mr. Abbot, and built by

the Dominion Bridge Company at Quebec. The total cost was £110,000.

LACHINE BRIDGE.

The Lachine Bridge is on the Canadian Pacific Railway, and has 20 spans of 242 feet. They are simple truss girders, carrying the rails on the top, except on the two channel spans, where the rails run between the girders. The cost is £250,000.

SUKKAR BRIDGE.

The Sukkar Bridge is built across the Indus and has a cantilever span of 790 feet in the clear, the clear centre span being 200 feet; the height of the cantilever is 40 feet, and it is supported with trussed iron guys 280 and 300 feet long respectively. The width of the members at the bed-plates is 100 feet, and at the cantilever ends and centre of back guys 20 feet wide. It is built of steel, and for a single track, and will weigh, exclusive of the clear centre 200 feet span, 3,000 tons. It was designed by Mr. Rendel and built by Westwood, Bailie, & Co., of Poplar, England. I am unable to state the cost, but the coffer dams cost £1,635, and the erection of the ironwork £4,354.

HAWKESBURY BRIDGE.

The Hawkesbury Bridge is to be built across the River Hawkesbury, in New South Wales, near its discharge into Broken Bay. It is to be 2,896 feet long, in five spans of 416 feet each and two spans of 408 feet each. The width will be 28 feet centre to centre of trusses. The total height from the bottom of the piers to the rail level will be 227 feet, the rail level being 42 feet above high water; the piers have to be sunk 185 feet. The sinking of the piers, which will be of wrought iron filled with cement concrete up to low-water level, will be watched with much interest. The piers are all oval in shape, being 20 feet wide and 48 feet long, of three-eighths inch boiler plate. Within this large tube three cylindrical tubes will be placed, and joined to the outer shell by bell-mouthed connections. These inner tubes are to be used for dredging the contents of the large tube, and by this means allowing it to sink to the required depth. The contract price for delivery and erection is £327,000, and the work is let to the Union Bridge Company, of New York, and a large portion of the ironwork is being executed in Glasgow.

IRON AND STEEL.

The question of Bridge construction leads me to touch upon the relative values of iron and steel for such purposes. In looking at these values, I find that in a paper read in August, 1885, Mr. Jeremiah Head, the President of the Inst. Mech.

Engineers, supplies the following reasons why steel made according to Lloyd's requirements is superior to iron for ship-building.

1st. It is very much more ductile.

2nd. It is equally ductile in both directions of the grain.

3rd. It has 30 per cent. more tensile strength in the direction of the grain.

4th. It has 50 per cent. more across the grain.

5th. Its elastic limit is 21 per cent. more in either direction of the grain.

He goes on to point out a curious and important fact, though little known, that the elastic limit in iron plates is equal in both directions, as it is in steel, although the ultimate strength and ductility are inferior in the cross direction.

It seems clear that mild steel has much less practical advantage over wrought iron when used for bridges and roofs than when used for ships.

STEEL FOR BRIDGES.

The great advantage gained by the use of steel for bridges and other similar work is its high elastic limit as compared with its weight, and in all large spans this is an important element, as the weight of the span is the principal cause of the strain, but, notwithstanding this, English engineers are slow to introduce steel very largely into general use, as wrought iron is still more used than steel in bridges and roofs and for agricultural implements.

RAILS, TYRES.

Closely connected with the use of steel for bridge and roof building is its application to rails, tyres, axles, &c. The use of steel rails is now almost universal, and they can be produced at a lower rate per ton than wrought iron rails. They are usually made by the Bessemer or Siemen's process, and are found to be infinitely superior in wear and tear to wrought iron. They should be tough, and yet not brittle under traffic, and able to stand the breaking and crushing effects produced by the locomotive wheels. Mr. Price Williams, a recognised authority, states that a steel rail will outlast nine iron rails under the same conditions of traffic, and it may be accepted as a fact beyond dispute that it will at least last double the time.

It is chiefly on account of the great resistance of steel to abrasion that this material has superseded iron for railway wheel tyres, but where such a quality is not absolutely essential, such as in ordinary works where bars, angles, and plates are used, and in bridges, roofs, and ships, iron is as good as steel, and steel is only used in consequence of its superior elastic limit in proportion to its weight. With regard to the application of

steel for axles of railway engines and rolling stock, experience has shown that this material is not altogether trustworthy, and the returns of the Board of Trade show that steel axles are not so reliable as iron.

During the year 1884, 385 axles failed on the English railways, killing 24 and injuring 75 passengers, and out of the 385 axles that failed 200 were locomotive crank axles, and the average mileage of iron crank axles for the same year was 216,333 miles, and of steel 173,287 miles, but the breakage of steel axles is not confined to crank axles, which are essentially of a weak form to resist the varying strains to which they are subjected, for numerous instances of the breakage of carriage and waggon axles have occurred, and are occurring, and I do not doubt that we shall eventually return to iron as the best material for railway axles.

TUNNELLING.

Tunnelling is executed with much greater dispatch now than formerly, in consequence of the introduction of rock drills driven by air or water, the use of better explosive compounds, and better system of ventilation.

The most recent examples of large tunnels completed are those under the Mersey at Liverpool, and under the Severn.

MERSEY TUNNEL.

The Mersey Tunnel, connecting Liverpool with Birkenhead, is 3,820 yards long, and is carried under the bed of the river, which is 1,320 yards in width. It is constructed for a double line of rails. It leaves the Central Station in Liverpool and joins the Central Station at Birkenhead, the distance being about two miles. The tunnel is 26 feet wide and 19 feet high, and is lined with brick-work, set in cement. It is ventilated with four "Guibal" fans, which work in separate air passages, 7′ 4″ diameter, cut through the rock and connected with the tunnel. There are two underground stations—one at Hamilton-square, the other at James-street, and being about 80 feet below the street level, are approached by an inclined subway and hydraulic lift 18 feet square, capable of seating 100 passengers. The underground portion of these stations is hewn from solid rock, and is 400 feet long, 50 feet wide, and 30 feet high. The traffic amounts to over 26,000,000 of passengers and 750,000 tons of goods per annum. The engineers were Mr. James Brunlees, with whom was associated Mr. Chas. D. Fox. The tunnel was formally opened to the public by H.R.H. the Prince of Wales on January 20th, 1886, and occupied six years in its execution. The length of the railway is three miles, and the cost has been £1,000,000.

SEVERN TUNNEL.

The Severn Tunnel is the largest work of the kind ever carried out in England. It passes under the river about half a mile below the railway ferry, and is 7,942 yards long, of which 3,960, or two and a-quarter miles, are under the bed of the river. The depth of water over the line of tunnel at high water is 96 feet, and at low water 60 feet. It is lined with brickwork in cement, the brickwork varying from 1 foot 10½ inches to 3 feet in thickness. The total cost is estimated at £1,500,000.

CASCADE TUNNEL.

The Cascade Tunnel on the Northern Pacific Railway has been commenced, and will be 9,880 feet long.

Tunnels have been projected under Mont Blanc and the Simplon, each being about twelve miles in length, but it is feared that after the experience of the St. Gothard Tunnel the heat in the centre of the tunnel would make it impossible for human beings to live in the atmosphere.

The great Dover Straits scheme has collapsed for a time, and it is much to be regretted that a work which seems so practicable should be deferred.

SUBMARINE BLASTING.

Regarding the removing of large masses of rock by tunnelling and blasting, we have an excellent example in the recent successful removal of Flood Rock in Hell Gate, New York Harbour, in October last year. By this one blast 200,000 cubic yards of rock were so disrupted as to render its removal by dredging an easy operation. The area of the work was nine acres, and 225,000 pounds of giant gunpowder and 75,000 pounds of dynamite were used on this occasion.

WATER SUPPLY.

Water supply is in this country at all events a very important subject for discussion, and I do not propose to discuss this question now, leaving it for those who have specially interested themselves in the subject to deal with it at some future time, my present intention being only to allude to the two great water schemes now in progress, viz., those in Liverpool and New York.

VYRNWY DAM.

The Vyrnwy Dam, from which it is proposed to supply the town of Liverpool, is to be built of masonry, and is to be 136 feet high in the centre, 1,258 feet long, and 117 feet thick in its greatest width, impounding 1,118 acres of water, from which an aqueduct 35 miles in length will convey the water to the town.

NEW YORK.

The works in New York are intended to supply 320 millions of gallons of water daily to the city. The works consist of a masonry dam 178 feet high, 1,300 feet long, and impounding 3,200 millions of gallons. The masonry dam has to be sunk 100 feet to reach rock foundation, so that its total height will be nearly 300 feet, and its bottom width 200 feet. The water will be conveyed by an aqueduct with its diameter averaging twelve feet, and will be 31 miles long to the Central Park Reservoir. The aqueduct crosses the Harlem River by means of a syphon 156 feet below the surface of the river.

RAILWAYS.

Some interesting information has been compiled in a paper read before the American Society of Civil Engineers, "English and American Railroads compared," by Mr. B. Dorsey. He states that in 1883 there were in England 18,681 miles of railway, costing over £40,000 per mile, and at the same date there were completed in America 110,414 miles, costing on an aver-average £12,400 per mile; the operating expenses of the English lines being £2,000, and of the American, £880 per mile. The ton mileage of the English was 9,589,786,848 and of the American 44,064,923,445, and passenger mileage 5,494,801,496 and 8,817,684,503 respectively.

Assuming that the above statements are correct, considerable allowance must be made for the difference in the value of the land traversed by the railways in the two countries, and, although the cost of floating railway companies in America is great—amounting in some instances to £2,000 to £3,000 per mile—yet when you value the different conditions under which the work is carried out in the two countries, there is no doubt that railways can be and are made more economically in America than in England, and a perusal of an excellent paper written by Mr. Robert Gordon before the Institution of Civil Engineers will throw much additional information upon the subject. This paper is "On the Economical Construction and Operation of Railways in countries where small returns are expected, as exemplified by America." This subject, although of great interest to us as colonists, would occupy too much time to enter into on the present occasion, but I will briefly refer to one or two points mentioned in the above paper.

The author attributes one of the great and essential features in the American as compared with English practice to the adoption of types capable of automatic reproduction in identical forms where practicable. In one case alone, the whole railway system of America will shortly be of one universal gauge of

4 feet 8½ inches, and I think it worth while recording the fact that between May 31st and June 3rd of this year the gauge of 11,500 miles of railway was changed to the standard with scarcely any impediment to traffic.

Up to the present time the only standard article accepted is the freight-car axle, and it is expected shortly that a standard size of wheel and shape of tyre will be agreed to. One important feature in the shape of the tyres likely to be introduced and adopted is that the portion under ordinary circumstances in contact with the rail shall be cylindrical for a width of two inches, and the remainder coned as usual for use when running round curves.

It is customary in the United States, where timber is comparatively cheap and good ballast scarce, to use a larger number of sleepers per mile and a less quantity of ballast than usual; but there is a decided determination among the leading American engineers not to use light rails either for narrow gauge or so-called light railways. Economy is to be sought for elsewhere than in either rolling-stock or permanent way. The principal economy is, therefore, to be found in the first cost of laying out and grading the line. It is interesting to note the results accruing from attempts to avoid heavy gradients by increasing the magnitude and cost of the earth and other works. Some of the Main Trunk Lines cross the ranges at very high levels, notably the Baltimore and Ohio line, which crosses the Appala chain range at an elevation of 2,706 feet by grades of 1 in 45 eleven miles long on one side, and seventeen miles long on the other, with curves of 600 feet radius.

The Pennsylvania Railway originally crossed the same range at an elevation of 2,160 feet with the gradients of 1 in 37 and 1 in 49, but these grades have been much improved since that time. The Erie Railway was originally most carefully laid out to get over a summit of 1,374 feet, and heavy expenses, amounting to £44,000 per mile, were incurred in obtaining a maximum grade of 1 in 88.

The New York Central has maximum grades of 1 in 56, with sharp curves; and its rival — the West Shore line — has a low summit level, with grades of 1 in 264 and 1 in 176, but the cost has been so great that it is feared the line will have to be absorbed by its rival, the New York Central. On all economical railways of the standard gauge moderately steep grades have been successfully adopted. The largest private company in the States, or in the world, is the Chicago, Milwaukee, and St. Paul. It owns and operates 5,000 miles of line.

The plan adopted in the United States is to locate the line carefully in the first instance, with the view to subsequent

improvements as traffic develops; and to this end the use of steep grades, the free use of curves and wooden structures are largely availed of—wood being used because it is plentiful, and is the cheapest and handiest material procurable. As the revenue of the country becomes larger and the business of the railway develops, the lines are improved, the grades lowered, the curves made larger, and permanent structures introduced. Whenever 40 per cent. of the gross earnings will pay the interest on the funded debt, the balance, after deducting operating expenses, is expended in making improvements. The rails are now all of steel—about 67 lbs. to the yard for trunk lines, 60 lbs. to the yard for minor lines; sleepers never less than 2,800 per mile. The average life of the timber bridges is nine to eleven years.

Mr. Gordon, from whose paper I have quoted largely, winds up with the following observations:—

I. There is no difference in the principles underlying the American practice in the location of light railways and that of the most expensive and perfect railways for heavy traffic, and that while the former is looked upon as an imperfect stage of development of the latter, due consideration is usually given and provision made for the growth and improvement of the line to a better condition as the traffic increases, with the least possible fundamental alteration in the line and its belongings. The highest engineering skill is as much, if not more, required in laying out a cheap and light as a heavy line.

II. The latest and best American practice rejects the use of light rails and permanent way for an economical railway. It must be prepared for the ordinary passenger and freight cars of the country to pass over, the only difference being that light loads would be carried on the lighter line at lower speeds. To fix these ideas without attaching precise value to figures, it might be expressed by saying that whilst 3,000 pounds per lineal foot of train appears to be the maximum load of a freight train on a heavy road at the present time, 2,000 pounds per lineal foot is a limit for a light railway, and the bridge-work should be calculated for these loads. Steel rails not less than 55 pounds per yard, and sleepers not less than 2,800 to the mile, with 15,000 super feet of bearing surface, should be used.

III. Some advocate light engines and frequent trains; others prefer heavier engines and fewer trains, with greater loads. In the Far West, where only one or two trains run each way per diem, the heaviest engines are frequently used, with trains loaded to the utmost.

IV. When no extra cost is incurred the same grades and curves that would be given to the best railway the country ad-

mits of should be used for the economical one. In the ordinary rough country the usual curvature is about 573 feet (or less than ten chains) radius, with gradients properly compensated—in fact, the practice was to use the best curves that the topographical nature of the country allowed. To use the words of Mr. Wellington, an eminent American engineer:—

"Roughly speaking, and excluding curves in stations, one-half of American mileage might be said to be built to a radius of 1,900 to 1,430 feet; half the remainder to 955 feet; half the remainder to not over 573 feet, and only about one-eighth to sharper radii, the standard maximum being 359 feet radius, which brought the cost in the roughest country within reasonable limits, and enormously below what twice the radius rendered possible; whilst on the other hand using any sharper radii than that best adapted to the given topographical conditions rarely saved more than an inconsiderable percentage."

Terminal and station facilities should be of the cheapest description, and level crossings should be used everywhere, and fencing dispensed with except in cattle-grazing districts.

The question to be solved in America and in all new countries is, "Shall we construct a cheap railway or have none at all?" This was essentially the case in Queensland, and it practically was the reason for the introduction into that country of 3′ 6″ or narrow gauge as it is termed. In America narrow gauge lines are not now built, and every year sees the change from the narrow to the standard gauge, 4′ 8½″, which is now being carried out at a very heavy cost, but the break of gauge has become so troublesome that the various Companies are only too desirous to adopt the standard. The best American practice was not a wasteful employment of heavy grades for the sake of saving distance and eliminating curves, but it was to get as low grades as possible for the longest portion of the distance, and to concentrate the heavy grades together and work them with extra engine power.

One important element should not be forgotten when we speak of the cheap system of railway construction adopted in America, and that is the country is generally well supplied with timber and water, thereby materially cheapening the construction.

ABT SYSTEM.

During the past year a very satisfactory system has been invented by Mr. Abt, of Switzerland, for overcoming mountain inclines. This problem has taxed the brains of many inventors, but the plan devised by Mr. Abt appears destined to supersede all others. He has abandoned the well-know rack rail with its two sides and rollers acting as teeth between them, and builds up a number of elementary racks, and places them side by side.

Each one of the elementary parts is nothing more than a rack in its simplest form, or a bar of iron or steel provided with teeth. Whatever may be the tractive power to be developed by the pinion working in the rack, by placing side by side the proper number of bars, each one is strained only to its chosen limit. The bars are connected by chairs and bolts, by which they are secured to the road bed. The bars are laid with broken joints, so that the teeth of one bar are slightly in advance of those in another. The pinion is similarly constructed of discs, and are stepped to suit the teeth in the rack. The discs have elastic springs of rubber between them and the shaft to which they are fixed, thus admitting of adjustment to any imperfection in the accurate manufacture of the racks. This works so well that at a speed of sixteen miles an hour there is no noise or blow whatever.

One characteristic feature in the system is the adaptation of the rack to the steepness of the gradient, the number or thickness of the elementary bars being chosen according to the traction required. Curves can also be easily traversed, which is not the case with the ordinary rack rail. This system has been most successfully used on the Hertz Railway, Prussia, and is being applied to the Höllenthal Railway, South Germany, and on the extensive slate quarries connected with the Bavarian State railways.

SHIP RAILWAYS.

An American engineer of some celebrity (Captain Eads) has conceived the idea of transporting ships overland by means of railways, and although considerable opposition has been offered to the scheme by engineers, it has been approved by Congress.

It seems to me a very difficult problem to solve, bearing in mind the enormous weight of the vessels now built, including their machinery and cargo, and it is difficult to conceive how the very large number of wheels required to carry this load without straining the ship can be moved over rails unless they are laid on an unyielding foundation with mathematical accuracy. The locomotive power to move such a mass would also be very great.

There is, however, a ship railway now under way from the Gulf of St. Lawrence to the bay of Fundy, and another is projected across the Florida Peninsula.

PANAMA CANAL.

Among the great works in progress may be mentioned the canal across the Isthmus of Panama. Grave doubts are expressed by many eminent American engineers as to the possibility, or rather the probability, of the successful completion of this great undertaking. Great faith is placed by the

French people in M. Lesseps' ability to carry out his scheme. In fact, his name exercises a spell over the majority of Frenchmen, who are looking forward with implicit confidence to the time when this great highway shall be opened.

It is more than 300 years ago since this project was first brought into notice by a Portuguese navigator (Antonio Galvao), and varying attempts have been made to carry out the undertaking. The great difficulty to be encountered will be in dealing with the valley of the Chagres River, which is known to be subjected to heavy and practically uncontrollable floods, which rise to a height of 40 feet in 24 hours. It is intended that this shall be a sea-level canal, but it is not improbable that if it is ever built at all it will be made with locks.

BALTIC CANAL.

Another scheme for a ship canal is that contemplated between the Baltic and North Seas, as well as the

MANCHESTER SHIP CANAL,

for which a charter has been obtained from the British Parliament, but from the latest advices there appears to be some difficulty in floating the latter scheme, owing to the opposition of the Railway Companies interested.

RECENT ATLANTIC STEAMERS.

The transition from ship canals to steamships is an easy one, and as a mark of the recent progress made in marine engineering as applied to transatlantic steamships I would refer briefly to the record of the steamship America, built for a British Company by Messrs. Thomson, the well-known Clydebank builders. This vessel is really an innovation in transatlantic voyaging, and was designed to steam through the water at the rate of 18 to 19 knots an hour continuously, and has proved equal to the tests imposed, not only in regard to her speed, but likewise in her consumption of fuel, as she burns only 180 to 190 tons of coal per diem when steaming at the above speeds, whereas the usual consumption of similar steamers at a much reduced speed is from 300 to 350 tons of coals per diem. She is built on the principles laid down by the late Mr. Froude, viz., that a comparatively short and broad vessel with a fine entrance and run aft, carried on continuous curving lines, could be driven through the water at a higher velocity than a long and narrow vessel of the same capacity, but with fine entrance and parallel sides.

The s.s. America is 459 feet long, 51 feet wide, and 38½ feet deep amidships. Her tonnage is 8,830, and carrying capacity 2,830 tons; her engines are 7,000 horse power, and at 66 revolutions give a speed in smooth water of 18 knots, and with

70 revolutions a speed of 19 knots, on a coal consumption of 180 tons per day. She carries 670 cabin and 300 second-class passengers, whose quarters are abaft the engines, which have one high-pressure cylinder 63 inches diameter, and two low-pressure, each 91 inches diameter and 66 inches stroke. The steam enters the cylinder at 90 lbs. per square inch. The time occupied in steaming from Liverpool to New York has been reduced from about eight days six hours to six days twelve hours.

ELECTRICITY.

Electricity seems destined to work great wonders, and tends to develop, if not to solve, the great problem of transportation. It has already been successfully applied to the working of tramways, and I do not think that the day is far distant when it will be employed in many instances to supersede steam in propelling steamships and drawing railway trains. Immense progress has been made during the past twelve months in developing the application of electricity to street-railway transit, especially on the Continent of Europe. It is only recently that the application of electric and magnetic currents has been extensively used in some of the larger cities, and the electric motor, as now perfected, certainly justifies the belief that it will be the motive power in the future. Professor Thompson has asserted as his opinion that electrical energy used for the transmission of power has a far greater future before it than its transformation into light. Professor Ayrton also is confident of the future use of electricity as a motive power for our railways which will combine speed, economy, and safety, and entirely abolish smoke and other inconveniences. The "Daft" motor, the Antwerp tramway tests, the Siemens and Holske electric locomotive, and several American machines of like nature show that the electric railway is gaining upon its rival the steam railway.

ANTWERP.

At Antwerp five motors were tested—three propelled by direct steam action, and two by direct stored-up force supplied by a fixed engine. After a trial of four months' duration the first prize was awarded to the electrical motor driven by accumulators, which consisted of Faure batteries, from which the car was also lighted at night with incandescent lamps. The car weighed 5,654 lbs., the accumulators weighing 2,400 lbs.; the weight of the machinery, including the dynamo, was 1,232 lbs., and carried about 34 passengers.

Electricity has been also employed for colliery purposes—the locomotives carrying their own storage of current, consisting of a series of accumulators, whose weight was usefully em-

ployed in increasing the adhesion of the car-wheels to the rails.

BESSBROOK, NEWRY.

At the Bessbrook spinning works, Newry, Ireland, there is an electric tram running having a capacity for 34 passengers. The trams surmount grades of 1 in 85 at a speed of seven miles an hour easily. The motive power is supplied by a turbine wheel, the conductor being an inserted steel channel laid on insulators between the rails.

SIEMENS AND HOLSKE.

The Siemens and Holske electric railway from the Military Academy at Berlin to Potsdam, eight miles distant, is in successful operation on an ordinary railway, insulated wheel tyres being used to take off the current.

BLACKPOOL.

An electric tramway has been installed at Blackpool, England. The electrical portion of this line is placed beneath the surface of the street, and the rails are not used as in the previous case at Berlin, but the conductor consists of two copper elliptical tubes having a wide slot for attachment to iron studs supported upon porcelain insulators, fixed to creosoted blocks of wood. The tubes are attached to the studs by wooden wedge pins. This line is working very satisfactorily.

ECONOMY OF ELECTRICITY AS A MOTIVE POWER.

As an economical agent for propulsion it is claimed for electricity that when used as a motor every pair of wheels can be utilised for pulling or retarding. That by a suitable proportion in the speed of the generator to that of the electro motors 70 per cent. of the effect given out by the generators can be utilised.

It has also been demonstrated that a power equal to that developed by one horse can be obtained from an electro motor for every 50 lbs. dead weight of car.

It is also claimed that when the rails are used as a medium through which the electric current passes there is no chance of accident from a broken rail, as the current would be either broken or so much attenuated as to cause a stoppage of the motor. Each horsepower of effective energy developed by the stationary engine that supplies the power will produce in the electro motor an effective energy equal to one-half horsepower.

The motion communicated to the electro motor being circular and not reciprocating as in an ordinary steam engine, it is claimed that all shocks and jars are avoided, and the maintenance of the motive machinery, permanent way, bridges, &c.,

are materially reduced, so that eventually greatly increased speed will be possible with complete safety.

NORTH METROPOLITAN.

A new electrical engine of the North Metropolitan Tramway Company, Stratford, England, solves the problem of economical working by combining electrical power with the aid of the mechanical application of the lever. The engine consumes only two tons of coals per week, and will charge batteries sufficient to do the work of four cars, requiring 44 horses per week.

A curious fact connected with the development of the electro motor occurred in Paris during the Exhibition in that city in 1873, when one of the workmen engaged in fixing the dynamo by a mistake connected together the wires of the Gramme dynamos, with the result that the electricity from one dynamo caused the shaft of the other to revolve rapidly. This blunder gave to the world the principle of the power of reversing the dynamo, and formed the germ of the electrical railway.

WORKING RAILWAYS BY AID OF ELECTRICITY.

Without the aid of electricity the working of the railway system of the present day with safety would be almost if not quite impossible.

BLOCK WORKING.

By its means the block working of trains is carried on, and it is now almost impossible to have what are known as "rear collisions" on double lines where the system is in use.

LOCKING SIGNALS BY ELECTRICITY.

One system that came under my notice when travelling in England was the application of electricity to lock the starting signals from one station to another by making the train itself perform the duties necessary for completing the signals, and restoring the electrical current for setting a second signal. By this means a signalman cannot lower his train-starting signal to allow it to proceed to the next station until the signalman at the station in advance has in reply to an arranged bell code unlocked the signal lever. The electric lock having been taken off enables the signalman to lower the signal, and on putting it to danger again after the departure of the train to protect it he cannot lower it again for a second train to follow on the same line until the lock is removed by the signalman at the station in advance, and he is unable to take off this lock until the first train has passed a certain point fixed by the railway authorities. When the train passes this point the apparatus in the signalman's box in the rear is re-set by the action of the train itself, the weight of which deflects the rail and makes contact whereby the apparatus is re-set for the next following

train. By this system the men at each end of a section cannot make a mistake, and the men themselves are controlled by the action of the train itself until it is clear of the section.

TABLET SYSTEM.

There is a very ingenious electrical apparatus used for working single lines of railway, which works most admirably. It consists of a box containing tablets, and is fixed at each end of a section of the railway—say at every station. It is necessary that the driver of the train should have one of these tablets given to him before he can leave the station at which he is standing. The tablet is given by the stationmaster to the guard, and by him to the engine-driver, so that both may know they have the necessary authority to start. But before the stationmaster can remove one of these tablets from the box containing them he must first communicate with the station in advance, when the stationmaster there, if the line is clear, releases one of the tablets by sending an electric current through for the purpose; and before another tablet can be taken from the box at either station for a train to proceed in either direction the tablet in the possession of the engine-driver of the train occupying the section must be previously placed in the box at the station in advance on its arrival there, thereby rendering a mistake almost impossible.

ELECTRIC LIGHTING.

When in America I noticed with much interest the plan of electric lighting adopted in some of the cities. It consisted of mounting the light or lights upon a tall mast, or framework of iron. If it is required to light a square, it is accomplished by erecting a tall mast in the centre, and having a ring of arc or other lamps fitted to it, and a very good and sufficient light is thereby obtained. If it is required to light the intersection of two thoroughfares, then a light iron framework springing from each curb and uniting at the top where the lights are attached. This forms an excellent method of lighting. The London and South-Western Railway Company of England have adopted the high-mast system for lighting their goods-yard at Nine Elms, and it answers admirably, facilitating, as it does, the marshalling of trains, and preventing to a considerable extent the practice of thieving from the waggons and sheds.

Time will not permit me to refer to many other subjects of great interest, such as the nature and use of

NATURAL GAS,

as found in Pennsylvania. It is used for domestic as well as for manufacturing purposes, iron, steel, and glass factories using it instead of coal. It also, when imperfectly burned,

deposits carbon of considerable density, and sufficiently good to be used for the purposes of the electric light. It absorbs and carries off oil and grease when used under pressure, and is employed for cleansing delicate fabrics. It produces superior glass to that obtained by fusion with coals, and covered pots for this purpose are found to be unnecessary.

Before concluding I would like to refer to the progress made in

MILITARY ENGINEERING WITH REGARD TO ARMOUR-PLATE AND WEAPONS.

Great progress has been made during the past few years in this direction, and shields, cupolas, &c., are now made from chilled cast-iron as well as of steel.

CHILLED CAST-IRON ARMOUR PLATE.

The Gruson chilled cast-iron armour plate, which lately withstood most successfully three shots from the 16-inch 100-ton gun at Spezzia, has just successfully resisted a fourth shot, although it struck the plate at a point where it had been weakened by previous shots. This experiment has yielded the best results on record of any armour-plate up to the present time.

The experiments made in the improvements in construction of torpedoes still continue, and the perfection to which these dangerous weapons are now brought is marvellous; they can be steered in any direction, and manœuvred with the greatest ease. Nitro-glycerine has also been successfully used in filling shells for destructive purposes; but one of the most successful machines lately introduced has been the Maxim gun.

MAXIM GUN.

This gun is automatic, and is the invention of Mr. Hiram Maxim, of London, and it differs very materially in its action from the machine guns generally adopted. The first mechanical gun of any practical value was invented by an American, Dr. Gatling, in 1863, and they were used extensively during the American War in 1865. Subsequently another American—Mr. Hotchkiss—invented a machine gun, and took his invention to France, where these guns are extensively manufactured. The Nordenfelt and the Gardner guns followed in rotation. All these guns require manual labour in loading, firing, and discharging the empty shells. They also have magazines for the ammunition holding from a dozen to 100 cartridges. The workmanship in these guns, to be reliable, must be of the very best, and the great fault found with them in action is their liability to jam or hang fire.

The Maxim gun, which I propose to shortly explain, is

entirely automatic, and the chief feature is that the recoil is used for loading and firing. The gun is about 4 feet 9 inches long, and stands on a tripod 3 feet 6 inches high. The cartridges are placed in a canvas belt made in two lengths, rivetted together at regular intervals so as to form loops, into which the cartridges are first inserted by hand. In order to keep up continuous firing a fresh belt is hooked on to the end of the one that is running, and no delay ensues. A water-jacket encircles the barrel, which prevents the excessive heating caused by the rapid discharge. To fire the gun all that is necessary is to turn a handle, which brings the first cartridge into the barrel. On pulling the trigger the first cartridge explodes and the empty shell is expelled from the breech, which instantly receives a fresh cartridge from the magazine, which is pressed firmly home by the breech-block closing and locking the breech completely during the explosion; and it cannot be unlocked again until the barrel, which participates in the recoil, has moved backwards about seven-sixteenths of an inch. By this time the shot is some distance out of the barrel, and the pressure of the gases is sufficiently reduced to render it safe to open the breech. The barrel still recoils, and while it is stopping the breech-block, with its attachments, is sent further backwards, thereby removing the empty shell and cocking the hammer. The return or forward travel of the block pushes another cartridge into the barrel, closes the breech, and pulls the trigger, and so on. On pulling the trigger by hand, the first shot is fired; the gun will then supply itself from the belt, and continue firing as long as there are any cartridges in the belt. For naval purposes larger guns are made, to take shells $1\frac{1}{4}$ inch diameter and 6 inches long, and will fire 150 shots a minute. A six-pounder, capable of piercing four inches of steel plate, will fire 50 shots a minute.

HEAVY GUNS.

Forging guns from steel is carried on on a large scale both in England and on the Continent. Herr Krupp, the owner of the extensive steel works at Essen, has just completed two giant guns intended for the defence of Pola, in the Adriatic Sea. The length of each cannon is 34·1 feet, the diameter at the bottom 4·75 feet, and at the mouth 2 feet. The transport of these guns from Essen to Pola will cost £300. They will be carried on sixteen-wheel trucks specially constructed, and weighing 39 tons, and having a carrying capacity of 75 tons.

I fear I have trespassed too long upon your patience this evening, my difficulty being to know when to stop my address, having left untouched so many subjects of general interest. I hope, however, that during the coming session some of our

members will find leisure to give us papers on electricity, water supply, and water conservation, as applied to this colony in particular, the influence of tree-planting as regards rainfall and climate, sanitary engineering, the possibility of the application of irrigation in this colony with water obtained from artesian borings, &c., and other subjects of importance to us as colonists.

THE TREASURER IN ACCOUNT WITH THE ROYAL SOCIETY OF SOUTH AUSTRALIA.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
October 1st, 1885.			By Cost of Transactions—		
To Balance brought forward		367 2 2	Printing and Binding	82 2 2	
" Subscriptions—			Illustrating	13 15 0	
Royal Society	92 2 6		Publishing	5 5 11	
Field Naturalists' Section ..	25 0 0				101 3 1
Microscopical Section	11 2 6		" Salaries, &c.—		
		128 5 0	Assistant Secretary	21 0 0	
" Government Grant—			Attendant	1 9 0	
1884-5 (second instalment) ..	28 15 2				22 9 0
1885-6	54 12 9		" Advertising		3 1 6
		83 7 11	" Printing, Postage, and Stationery ..		19 4 10
" Interest—Savings Bank		9 7 6	" Library—Binding		17 3 6
			" Field Naturalists' Section—		
			Grant	20 0 0	
			Printing and Stationery	5 1 6	
					25 1 6
			" Microscopical Section—		
			Grant	11 0 0	
			Advertising	0 17 6	
					11 17 6
			" Balance—		
			Bank of South Australia	128 14 2	
			Savings Bank	259 7 6	
					388 1 8
		£588 2 7			£588 2 7

Audited and found correct,

LIONEL C. E. GEE, Auditor.

October 5th, 1886.

WALTER RUTT, Treasurer.

DONATIONS TO THE LIBRARY

For the Year 1885-6.

I.—Transactions, Journals, and Reports.

Presented by the respective Societies, Editors, and Governments.

Baltimore, U.S.A.—American Chemical Journal, vol. VI., No. 5, 6; vol. VII., No. 1, 3, 4, 5.

——————— Johns Hopkins' University Circulars, vol. IV., No. 36, 38, 40, 42; vol. V., No. 43, 45.

——————— Johns Hopkins' University Studies in Historical and Political Science; Third Series, I., II., III., IV., V., VI., VII., IX., X., XI., XII.

——————— Ninth Annual Report of the President of the Johns Hopkins' University, 1884.

——————— Proceedings of the Trustees of the John F. Slater Fund for the Education of Freedmen, 1883, 1884.

——————— Memoirs of the National Academy of Sciences, vol. III., part 1.

Batavia—Natuurkundig Tijdschrift voor Nederlandsch-Indië, utgegeven door de Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië, Deel XLV.; Achtste Serie, Deel VI.

Belfast—Report and Proceedings of the Belfast Natural History and Philosophical Society for 1884-5.

Berlin—Sitzungberichte der königlich-Preussischen Akademie der Wissenschaften zu Berlin; Nos. 40 to 44, 1884; 1885, 1 to 39, 40 to 52.

Bombay—Journal of the Bombay Natural History Society, vol. I., No. 2, 3.

Bonn—Verhandlungen des naturhistorischen Vereines der Preussischen Rheinlande und Westfalens; 1882 (one part), 1883 (two parts), 1884 (two parts). Do., 1883 and 1884.

Boston—Proceedings of the Boston Society of Natural History, vol. XXIII., part 1, 4.

———Memoirs of the Boston Society of Natural History, vol. III., No. XI.

———Proceedings of the American Academy of Arts and Sciences; New Series, vol. XII.; whole Series, vol. XX.

Cambridge, U.S.A.—Bulletin of the Museum of Comparative Zoology at Harvard College, vol. XII., Nos. 2, 3, 4, 5.

——————— Twelfth Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College, 1884-5.

——————— Bulletins, Nos. 2, 3, 4, 6, 7, 8, 11.

Canada—Proceedings of the Canadian Institute, Toronto; Third Series, vol. III., No. 143.

——— Summary Report of the Operations of the Geological and Natural History Survey of Canada, part 3.

Cape Town—Transactions of the South African Philosophical Society, vol. III., part 2.

Colorado, U.S.A.—Proceedings of the Colorado Scientific Society, vol. I., 1883-4.

Dublin—Scientific Transactions of the Royal Dublin Society, vol. III., series 2, parts 7 (duplicate), 8, 9, and 10.

——— Scientific Proceedings of the Royal Dublin Society, vol. IV., New Series, parts 7, 8, 9; vol. V., parts 1, 2.

Edinburgh—Proceedings of the Royal Physical Society, vol. VIII., part 2.

Göttingen—Nachrichter von der Konigl. Gesellschaft der Wissenschaften und der Georg. Augusts. Universität zu Gottingen, Aus dem Jahre, 1884; Nro. 1-13.

Greensburg, Pa., U.S.A.—From Frank Cowan, "Australia: A Charcoal Sketch."

Lausanne—Bulletin de la Société Vandoise des Sciences Naturelles 2e S; vol. XXI., No. 92-93.

Leicester—Provincial Medical Journal; vol. V., No. 49, 55.

London—Journal of the Royal Microscopical Society; Series II., vol. V., Parts 5, 6,; and vol. VI., Parts, 1, 2, 3, 4.

——— Transactions of the Entomological Society of London for 1885.

Mexico—Annario del Observatorio Astronomico Nacional de Tacubaya para el Ano de 1886. Formido bajo la Direction del Ingeniero Angel Anguiano. Ano VI.

——— Antropologia Mexicana. El Hombre del Peñon.

Noticia Sobre el Hallazgo de un Hombre Prehistorico en el Valle de México. From Mariano Barcena.

Manchester—Report and Proceedings of the Manchester Field Naturalists' and Archæologists' Society for 1885.

——— Journal of the Manchester Geographical Society, 1885. Vol. I., Nos. 1, 2, 3.

Montreal—Geological and Natural History Survey of Canada. Contributions to Canadian Palæontology. Vol. I.

Munchen—Sitzungberichte der Mathematish-Physikalischen Classe der K. B. Akademie der Wissenschaften zu Munchen. 1884, Heft 2, 3, 4; 1885, Heft 1, 2, 3.

——— Abhandlungen der Mathematisch-physikalischen Classe der Königlich-Bayerischen Akademie der Wissenschaften Fünfzehten Bandes, Zweite abtheilung. In der Reihe denkschriften der LII., Band. 1885.

New South Wales—Australian Museum. Report of the Trustees for year 1884.

——— Catalogue of the Echinodermata in the Australian Museum. By E. P. Ramsay, F.R.S.E., &c. Presented by the Trustees.

——— Proceedings of the Linnean Society of New South Wales. Vol. X., parts 3, 4.

Do., do., New Series. Vol. I., parts 1, 2.

——— Descriptive Catalogue, with Notes, of the General Collection of Minerals in the Australian Museum. By Felix Ratte. Published by order of the Trustees.

——— Royal Society of New South Wales. President's Address, 5th May, 1886. By the author.

——— Royal Society of New South Wales. Results of Rain and River Observations made in New South Wales during 1885. By H. C. Russell, B.A., &c.

——— Local Variations and Vibrations of the Earth's Surface. By H. C. Russell, B.A., F.R.A.S., &c.

——— Catalogue of the Library of the Linnean Society of New South Wales.

——— Sydney University Calendar, 1886.

———————— Australian Museum. Report of the Trustees for 1885.

———————— Annual Report of the Department of Mines for 1886.

New York—Annals of the New York Academy of Sciences, vol. II., No. 8.

———— Transactions of the New York Academy of Sciences, vol. III., 1883-4 and 1885-6.

New Zealand (from Colonial Museum of New Zealand, James Hector, Director)—Handbook of New Zealand; fourth edition.

———————— New Zealand Court, Indian and Colonial Exhibition, 1886.

———————— The Recent Volcanic Eruptions.

Philadelphia, U.S.A.—Proceedings of the Academy of Natural Sciences of Philadelphia, part II., of 1885.

Queensland—Classified Index to the First Supplement to the Indigenous and Naturalised Plants of Queensland; F. Manson Bailey, F.L.S.

———————— Queensland Woods: Catalogue of the Indigenous Woods contained in the Queensland Court, Colonial and Indian Exhibition of 1886; F. M. Bailey, F.L.S.

———————— A Synopsis of the Queensland Flora, containing both the Phænogamous and Cryptogamous Plants; Fredk. Manson Bailey, F.G.S., Colonial Botanist.

Salem, Massachusetts—Bulletin of the Essex Institute, vol. 15, complete; vol. 16, complete.

———————————— Peabody Academy of Science. Eighteenth Annual Report.

South Australia—Report of the Geological Character of Barossa and Para Wirra. H. Y. L. Brown, F.G.S., &c., Government Geologist.

———————————— Report on the Fusicladiums, &c., by Frazer S. Crawford. Presented by the Government of South Australia

Tasmania—Papers ordered by the Legislature to be printed.

———————— Royal Society of Tasmania. Abstract of Proceedings, July 13, 1886, August 10, 1886.

Turin—Bollettino dei Musei di Zoologia ed Anatomia comparata della R. Universita di Torino, vol. I., Nos. 1 to 8.

Victoria—Australasian Statistics for 1884, with Report.

———————— Observations of the Southern Nebulæ made with

the Great Melbourne Telescope from 1869 to 1885; part II.

——— Statistical Register of the Colony of Victoria for 1884; parts V., VI., VII., VIII., IX. Index and Agricultural Statistics.

——— Statistical Register of the Colony of Victoria for 1885; part I., Blue Book; II., Population; III., Finance.

——— The Australasian Scientific Magazine, vol. I., Nos. 3, 4.

——— Victorian Naturalist, vol. II., Nos. 8, 9, 10; vol. III., Nos. 1, 2.

——— Victorian Year-Book, 1884-5; by H. H. Hayter. Three copies.

——— Seventh Annual Report of the Government Statist in connection with Friendly Societies, 1884.

——— The Chemist and Druggist of Australasia, vol. I. No. 4 and No. 5.

——— School of Mines, Ballarat. Annual Report for 1885.

——— Descriptive Notes on Papuan Plants; F. von Mueller; No. VIII.

——— Select Extra-Tropical Plants, 1886 edition; F. von Mueller. Presented by Government of Victoria.

——— Department of Mines, &c., Victoria. Reports of the Mining Registrars for Quarter ended March, 1886.

——— Field Naturalists' Club of Victoria. Sixth Annual Report.

——— Myoporinous Plants of Australia—II., Lithograms; F. von Mueller.

Vienna—Kaiserlich Academie der Wissenschaften in Wien. Sitzung der Mathematisch-naturwissenschaftlichen Classe; Nos. XIX. to XXIV., of 1885, 25 to 27 index and title-page, 1886; No. 1—4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 18.

——— Annalen des K.K. Naturhistorischen Hofmuseums redigirt von Dr. Franz Ritter von Hauer, Jahresbericht, fur 1885; Band I, No. 1.

——— Mittheilungen des Ornithologischen Vereines in Wien; 9 Jahrgang, Nos. 20–32; 10 Jahr., No. 1.

——— Verhandlungen der Kaiserlich-Königlichen Zoologisch-botanischer Gesellschaft in Wien; Jahrgang, 1884 and 1885, Nos. 1 to 15 of 1885; also 17, 18, and No. 1 of 1886.

——— Personen-Ort-und, Sach-Register (1871-1880), der K.K. Zool.-botanischen, Gesellschaft in Wien.

Washington—Monographs of the United States Geological Survey, vols. VI., VII., VIII., vols. III., IV., V., and atlas to vol. III.

———— National Academy of Sciences.—Proceedings, vol. I., part 2.

———— National Academy of Science.—Report for 1883.

———— Report for 1884.

———— Third Annual Report of the Bureau of Ethnology, 1881-2.

———— Report of the International Polar Expedition to Point Barrow, Alaska.

———— Annual Report of the Board of Regents of the Smithsonian Institute for 1883.

———— Annual Report of the Comptroller of the Currency. H. M. Cannon.

———— Fourth Annual Report of the United States Geological Survey, 1882-3.

———— Mineral Resources of the United States, 1883-4 (U.S. Geological Survey).

———— Bulletins of the United States Geological Survey; Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.

———— Memoirs of the Washington Academy of Sciences, vol. II.

———— United States Geological Survey.—Contributions to American Ethnology, vol. V.

———— Annual Report of the Bureau of Ethnology, 1880-81.

Würzburg—Sitzungberichte der Physicalisch-Medicinischen Gesellschaft zu Würzburg; Jahrgang, 1885.

LIST OF FELLOWS, MEMBERS, &c.

NOVEMBER, 1886.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Fellows. Those marked with an asterisk have contributed papers.

		Date of Election.
HONORARY FELLOWS.		
Barkley, Sir Henry, K.C.M.G., K.C.B.	.. .. ..	1857
Ellery, R. L. J., F.R.S.	Melbourne	1876
*Garran, A., LL.D.	Sydney	1853
*Hull, H. M.	Hobart	1855
Jervois, Sir W. F. D., K.C.M.G., C.B.	New Zealand	1878
Little, E.	.. .. ..	1855
Macleay, Hon. W., F.L.S... ..	Sydney	1878
*Mueller, Baron F. von, K.C.M.G., F.R.S.	Melbourne	1879
Russell, H. C., B.A., F.R.A.S. ..	Sydney	1876
Warburton, Col. P. E., C.M.G. ..	Beaumont	1858
*Woods, Rev. J. E. T., F.L.S., F.G.S.	Sydney	1877
CORRESPONDING MEMBERS.		
Bailey, F. M., F.L.S.	Brisbane..	1881
Canham, J.	Stuart's Creek	1880
Chandler, T.	Peake	1881
*Cloud, T. C., F.C.S.	Wallaroo	1881
*East, J. J.	Mallala	1884
*Foelsche, Paul	Palmerston	1882
Goldstein, J. R. Y.	Melbourne	1880
*Hayter, H. H., M.A., C.M.G., F.S.S.	Melbourne	1878
Holtze, Maurice	Palmerston	1882
*Kempe, Rev. J.	Finke	1880
Nicholay, Rev. C. G.	Fremantle, W.A.	1886
*Richards, Mrs. A.	Port Augusta	1880
*Scoular, Gavin	Smithfield	1878
*Stirling, James, F.L.S.	Omeo	1883
FELLOWS.		
*Adamson, D. B.	Adelaide	1867
Adcock, D. J.	Adelaide	1887
Angas, J. H.	Angaston	1874
Black, A. B.	Adelaide	1882
Boettger, Otto	Adelaide	1884
Bragg, Prof.	Adelaide	1886
Brown, J. E., F.L.S.	Adelaide	1882
Brown, L. G.	Two Wells	1882
Browne, H. Y. L., F.G.S.	Adelaide	1883
Bruer, J.	Adelaide	1883
Brunskill, Geo.	Morgan	1878
Burchell, F. N.	Adelaide	1881
Bussell, J. W.	Adelaide	1884

*Campbell, Hon. Allan, M.L.C., L.R.C.P. Edin.	Adelaide	1882
*Chalwin, Thos., M.R.C.V.S. Eng.	Adelaide	1877
Chapple, F., B.A., B.Sc.	Prince Alfred College	1876
*Cleland, W. L., M B., Ch.M., F.R.M.S.	Parkside	1879
*(L)Cooke, E.	Adelaide	1876
*Cooke, W. Ernest, B.A.	Adelaide	1885
Cox, W. C.	Semaphore	1880
Cornish, W. H.	Adelaide	1883
*Crawford, F. S.	Adelaide	1865
*Davenport, Sir Samuel	Adelaide	1856
Davies, Edward	Adelaide	1882
Davis, F. W.	Adelaide	1882
Dixon, Samuel	Adelaide	1887
Dobbie, A. W.	Adelaide	1876
Elder, Sir Thomas	Adelaide	1871
Fleming, David	North Adelaide	1886
*Fletcher, Rev. W. R., M.A.	Kent Town	1876
Foote, H.	Outalpa	1883
Fowler, W.	Kulpara	1882
Gall, David	North Adelaide	1865
Gardner, Wm., M.D., C.M.	Adelaide	1882
Gee, Lionel C. E.	Adelaide	1882
Gill, George	Adelaide	1884
Gill, H. P.	Adelaide	1883
Gill, Thomas	Adelaide	1885
Gosse, John, M.R.C.S.	Wallaroo	1884
*Goyder, Geo., jun.	Adelaide	1880
Grundy, E. B.	Adelaide	1882
*Haacke, Wm., Ph.D.	Adelaide	1882
*Harris, C. H.	Adelaide	1883
Harris, T. W.	Adelaide	1882
Harrold, A. L.	Adelaide	1876
*Haslam, John	Adelaide	1883
Hay, Hon. A., M.L.C.	Adelaide	1861
Henry, A., M.D.	Adelaide	1882
Hopkins, Rev. W.	Adelaide	1880
*Howchin, W., F.G.S.	Goodwood East	1883
Hughes, H. W.	Booyoolie	1883
*Hullett, J. W. H.	Port Augusta	1876
Johnson, J. A.	Adelaide	1875
*Jones, W. E.	Parkside	1885
*(F) Kay, R.	Adelaide	1853
Kelly, Rev. Robert	Mount Barker	1884
Knevett, S.	Adelaide	1878
*Lamb, Prof., M.A., F.R.S.	England	1883
*Laughton, E.	Adelaide	1874
Lendon, A. A., M.D.	Adelaide	1884
*Lloyd, J. S.	Adelaide	1856
*Lucas, R. B.	Adelaide	1885
Magarey, A. T.	North Adelaide	1873
*Magarey, S. J., M.B.	Adelaide	1874
Mais, H. C., M.I.C.E.	Adelaide	1883
*Mayo, Geo., F.R.C.S.	Adelaide	1853
Mayo, G. G.	Adelaide	1874
Mestayer, R. L., F.R.M.S.	Adelaide	1883
*Meyrick, E. B.A.	Sydney	1881
Middleton, W. J. E.	Kangarilla	1882

Mitchell, J. T., M.D.	Port Adelaide	1885
Molineux, A.	Kent Town	1880
(L) Murray, Hon. David, M.L.C. ..	Adelaide	1859
Munton, H. S.	Adelaide	1884
Nesbitt, W. Peel, M.B.	England	1880
Neale, W. L.	Adelaide	1884
O'Leary, M. P., M.R.C.S.	Port Victor	1884
Parker, Thomas, C.E.	Port Adelaide	1883
Phillips, W. H.	Adelaide	1883
Pickels, W. E., F.R.M.S.	Adelaide	1883
Poole, W. B.	Adelaide	1886
Poulton, B., M.D.	Adelaide	1883
Rigaud, R. J.	Adelaide	1882
Reed, T. S.	Adelaide	1885
Robertson, R., F.F.P.S.	Adelaide	1882
*Rennie, Prof., D.Sc., F.C.S. ..	Adelaide	1885
Renner, F. E., M.D.	Carrieton	1885
Russell, William	Port Adelaide	1879
*Rutt, Walter, C.E.	Adelaide	1866
Salom, Hon. M., M.L.C.	Adelaide	1866
*Schomburgk, R., Ph.D.	Adelaide	1865
Scott, Jas. L.	Hyde Park	1886
*Smeaton, Thos. D.	Mount Barker	1857
Smith, E. Mitchell	Adelaide	1883
Smith, R. Barr	Adelaide	1871
Smyth, C. B.	Adelaide	1884
Smyth, J. T., B.A., B.E.	Norwood	1882
*Stirling, E. C., M.D., F.R.C.S., M.P.	Adelaide	1881
Stuckey, J. J., M.A.	Adelaide	1878
*Tate, Prof. R., F.G.S.	Adelaide	1876
*Thomas, J. D., M.D.	Adelaide	1877
*Tepper, J. G. O., F.L.S.	Norwood	1878
*Todd, Charles, C.M.G., F.R.A.S. ..	Adelaide	1856
Tyas, J. W.	Adelaide	1882
Umbehaum, C.	Adelaide	1879
*Varley, A. K.	Mount Gambier	1883
Vaughan, A. P., M.B.	North Adelaide	1886
*Verco, J. C., M.D.	Adelaide	1878
Vickery, G.	Meadows	1868
Ware, W. L.	Adelaide	1878
Wainwright, E. H., B.Sc.	St. Peter's College ..	1883
Watson, Rev. John	Parkside	1884
Way, E. W., M.B.	Adelaide	1879
Way, S. J., Chief Justice	Adelalde	1859
Wheeler, F.	Adelaide	1884
White, R. A.	Adelaide	1882
Whiting, J. B.	Adelaide	1882
Whittell, H., M.D., F.R.M.S. ..	Adelaide	1882
Wilson, John, F.E.T.S.	Goodwood	1886
*Wragge, C. L., F.R.G.S.	Brisbane	1877
Young, Wm., M.A.	Hindmarsh	1880
Zietz, A.	Adelaide	1886

ASSOCIATES.

Burchell, D.	Adelaide	1883
Hodgson, Mrs.	Port Victor	1884

UNIVERSITY OF ILLINOIS-URBANA
506SOU C003
TRANSACTIONS.
8-9 1886-87
3 0112 009772523